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COMPLETED
ORIGINAL

FLOOD INSURANCE STUDY

SANTA CRUZ COUNTY, CALIFORNIA
UNINCORPORATED AREAS

VOLUME 1 OF 2

APRIL 15, 1986

Federal Emergency Management Agency

COMMUNITY NUMBER - 060353

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PUBLISHED SEPARATELY:

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FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Santa Cruz County, California, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for riverine areas in this study were performed by Brown and Caldwell, for the Federal Emergency Management Agency (FEMA), under Contract No. H-4723. This study was completed in April 1983.

The coastal analyses for the study were conducted by Ott Water Engineers, Inc., for FEMA under Contract No. EMW-83-C-1175. This study was completed in August 1984.

1.3 Coordination

Streams requiring detailed study were identified at the initial coordination meeting attended by representatives of the study contractor, FEMA, and Santa Cruz County, in April 1978.

Results of the hydrologic analyses were coordinated with the California Department of Water Resources, the U.S. Geological Survey (USGS), the U.S. Soil Conservation Service, and the U.S. Army Corps of Engineers (COE). The Santa Cruz County Farm Bureau, Santa Cruz

County Watershed Management Group, Santa Clara Valley Water District, Monterey County Flood Control and Water Conservation District, George S. Nolte and Associates, Creegan and d'Angelo, and Dewitt Engineering were also contacted for information pertaining to the study.

An intermediate/final coordination meeting was held on April 8, 1983, with local officials and representatives of FEMA and the study contractor. During this meeting, technical data on flood boundaries, floodways, and water-surface profiles were reviewed. The study was acceptable to the community.

Coastal areas requiring detailed study were identified at the initial coordination meetings between FEMA, the study contractor, and Santa Cruz County that were held on May 24, 25, and 27, 1983.

Engineering firms, residents, and business owners were interviewed at each of the detailed-study areas. The status of shore protection measures and the extent of recent coastal damage were noted.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Santa Cruz County, California. The area of study is shown on the Vicinity Map (Figure 1).

The study area encompasses the entire county and includes the San Lorenzo River, Soquel Creek, and Aptos Creek basins, part of the Pajaro River Basin, a number of small coastal basins, and portions of the Pacific Ocean. Not included in this study are the communities of Capitola, Santa Cruz, Scotts Valley, and Watsonville.

The flooding sources studied in detail are shown in Table 1.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1989.

Approximate study methods were used on many of the tributaries in the San Lorenzo River, Soquel Creek, Aptos Creek, and Pajaro River basins. These flooding sources include Bates Creek, Bear Creek, Bean Creek, Boulder Creek, Branciforte Creek, Browns Creek, Drew Lake, Gallighan Slough, Hare Creek, Kelley Lake, Kings Creek, Loch Lomond, Love Creek, Moran Creek, Newell Creek, Pinto Creek, Trout Creek, Two Bar Creek, Valencia Creek, and West Branch of Struve Slough. Additionally, upstream portions of Carbonera Creek, Corralitos Creek, Harkins Slough, the Pajaro River, and Soquel Creek were studied using approximate methods.

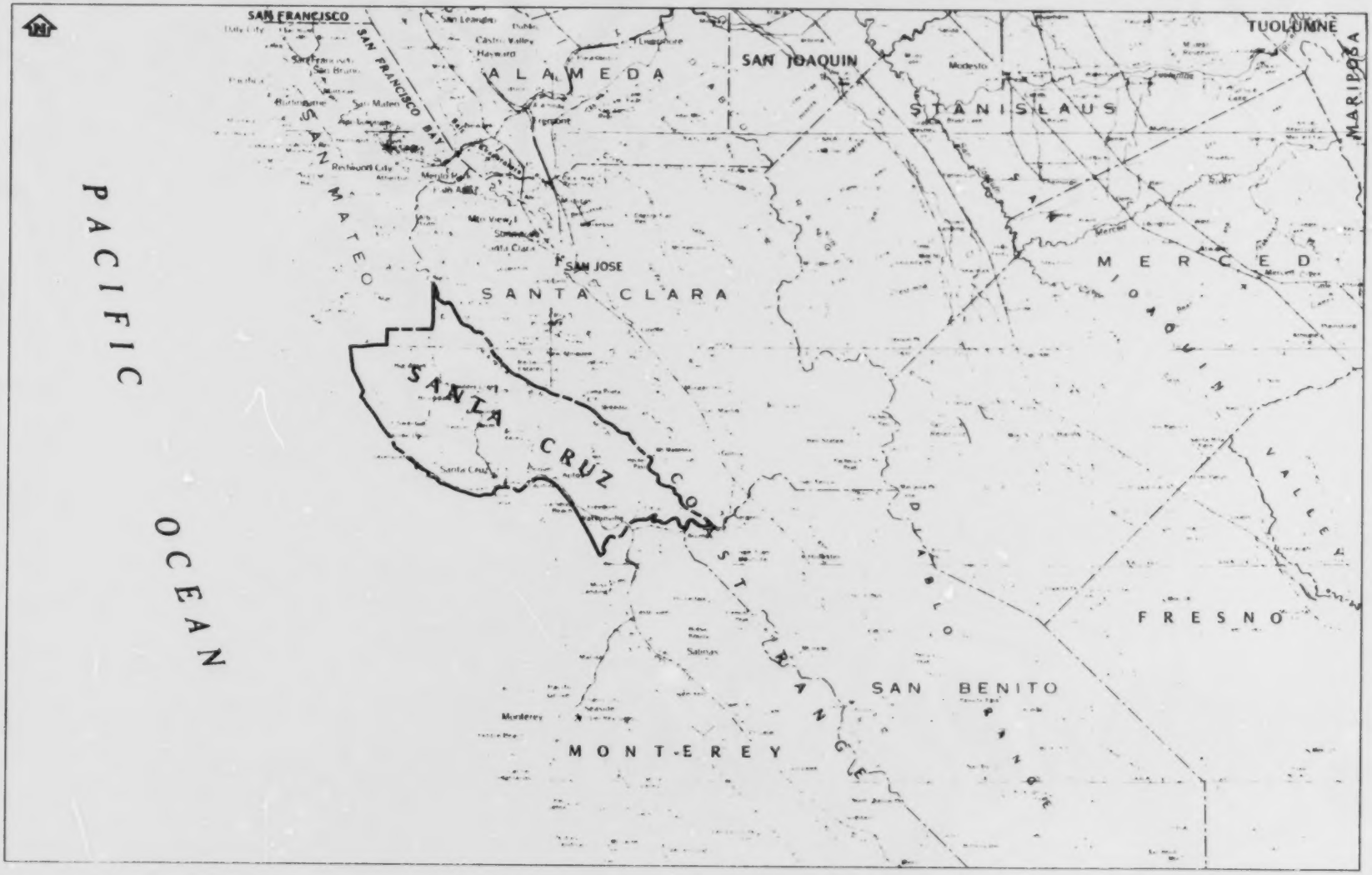

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

APPROXIMATE SCALE

16 0 16 32 48 MILES

VICINITY MAP

Table 1. Detailed Study Areas

Source of Flooding	Description
Aptos Creek	From the mouth at the Pacific Ocean upstream to 1,680 feet above the Southern Pacific Railroad bridge
Arana Gulch	From approximately 1,600 feet above Woods Lagoon upstream to 760 feet above State Highway 1
Carbonera Creek	From 1,290 feet above State Highway 1 upstream to 1,060 feet downstream of Carbonera Drive; at the City of Scotts Valley, from approximately 1,400 feet below State Highway 17 upstream to the southern corporate limits of Scotts Valley
College Lake	North of Corralitos Creek near Watsonville
Corralitos Creek	From East Lake Avenue upstream to 3,060 feet above Brown Valley Road
Coward Creek	From the confluence with the Pajaro River upstream to Lake Tynan
Harkins Slough	From the confluence with Watsonville Slough upstream to 4,550 feet above State Highway 1
Lake Tynan	Northeast of the City of Watsonville
Pajaro River	From the mouth at Monterey Bay on the Pacific Ocean upstream to 5,140 feet above Rogge Lane
Rodeo Creek Gulch	From the mouth at Monterey Bay on the Pacific Ocean upstream to 1,700 feet above Soquel Drive
Salsipuedes Creek	From the confluence with the Pajaro River upstream to East Lake Avenue where it becomes Corralitos Creek

Table 1. Detailed Study Areas (Cont'd)

Source of Flooding	Description
San Lorenzo River	From the northern corporate limits of the City of Santa Cruz upstream to 9,050 feet above Fern Drive
San Vicente Creek	From the mouth at the Pacific Ocean upstream to 3,710 feet above State Highway 1
Schwans Lagoon	East of the City of Santa Cruz along the Pacific Coast
Soquel Creek	From the northern corporate limits of the City of Capitola to approximately 6 miles upstream of Soquel Avenue
Struve Slough	From the confluence with Watsonville Slough upstream to the City of Watsonville corporate limits at State Highway 1
Thomasello Creek	From the confluence with the Pajaro River upstream to 1,060 feet above Riverside Road
Thompson Creek	From the confluence with the Pajaro River upstream to 3,825 feet above Capitola Road
Watsonville Slough	From the confluence with the Pajaro River upstream to the City of Watsonville corporate limits at Ford Street
Zayante Creek	From the confluence with the San Lorenzo River upstream to 4,500 feet above Western States Court
Pacific Ocean	From approximately 1,500 feet west of the mouth of Borregas Creek to 3,500 feet east along the Pacific Coast
	From the mouth of Aptos Creek to 9,500 feet south along the Pacific Coast
	From the mouth of the Pajaro River to 9,500 feet north along the Pacific Coast

The 13 streams located on small coastal basins including 12 west of the City of Santa Cruz and 1 southeast of Capitola were studied by approximate methods. These streams include Baldwin Creek, Laguna Creek, Majors Creek, Molino Creek, Old Dairy Creek, Peasley Gulch, Scott Creek, Yellow Bank Creek, Wadell Creek, Wilder Creek, two unnamed streams near Needle Rock Point, and an unnamed stream east of Capitola at Rio Del Mar.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and Santa Cruz County.

2.2 Community Description

Santa Cruz County is located approximately 60 miles south of San Francisco on the central coast of California. The major communities within the county are Santa Cruz, Watsonville, Capitola, Scotts Valley, Aptos, and La Selva Beach. Most of these communities occupy the low coastal terraces that form the northeastern shore of Monterey Bay, the only significant embayment on the coast of California between San Francisco Bay and Los Angeles Harbor. The county is bounded on the north by San Mateo County, on the east by Santa Clara County, and on the south by San Benito and Monterey Counties. The county as a whole covers 280,960 acres or approximately 438 square miles (Reference 1) and had a population of 188,141 in 1980 (Reference 2).

The portion of Santa Cruz County near the present sites of the Cities of Santa Cruz and Watsonville was explored in 1769 by an expedition led by Don Gaspar de Portola. Father Crespi, a member of the expedition, was the first to discover the redwoods near the present site of Watsonville. Settlers came with the founding of the Santa Cruz Mission in September 1791 (Reference 3).

Farming was first practiced near the Mission. Wheat, corn, and barley were the principal crops. Surrounding the Mission was a 10-acre fruit orchard consisting mainly of pear and olive trees and a few grapevines. Raising livestock was also important. By 1800 the Mission was exporting breadstuff, hemp, cordage, hides, and tallow (Reference 3).

In 1820, the first land grant was requested from the King of Spain by Don Antonio Maria Castro. When Mexico gained its independence from Spain, all grants came from Mexico. The early established ranchos were devoted almost exclusively to livestock grazing (Reference 3).

California was acquired by the United States in 1846. Santa Cruz County was organized in 1850, and Santa Cruz became the county seat. The population at that time was 643 (Reference 3).

Logging began in 1832. Amesti's Whipsaw Mill, on Corralitos Creek, was the first mill. Numerous new mills were built, and by the turn of the century nearly all of the readily accessible timber had been harvested. Approximately 15 million board feet of timber per year is cut in the area.

In 1851, some farmers settled in the Pajaro Valley. In 1858, Isaac Williams and Judge R.F. Peckham planted the first commercial apple orchard. By 1860 approximately 50 acres in the Pajaro Valley was in apple orchards, and by 1910 there were a million trees on 14,000 acres. The combination of poor apple years and new fruit and vegetable crops, however, began to lower the acreage in apple orchards. In 1974, 7,677 acres were in apple orchards (Reference 3).

Farming was greatly stimulated when the railroad came into the Pajaro Valley in 1870. Lettuce was planted in the valley in 1914 and a long distance market began in 1920 with the shipment of 38 railroad carloads of lettuce to Chicago (Reference 3).

The fresh-frozen food industry was started in the Pajaro Valley during World War II and has expanded to become a major source of employment. In 1950, fresh-frozen food packers in Watsonville produced 17.5 percent of all frozen foods processed in California (Reference 3).

The climate of Santa Cruz County is characterized by warm summers and mild winters. The average temperature is approximately 56°F. The Santa Cruz Mountains form a natural barrier to winds from the north and from the hot interior valleys. Both the mountain and the marine influence contribute to moderate temperatures. The average annual precipitation over the county ranges from 20 to 25 inches near the lowland coastal areas to 40 to 50 inches over the higher ridges inland. A frost-free period of 220 to 275 days promotes a long growing season in the county. Snowfall is infrequent in Santa Cruz County except at higher elevations in the Santa Cruz Mountains where accumulations rarely exceed 5 inches.

Soil is an important natural resource in the county. The rich alluvial soils of the Pajaro Valley, in the southeastern portion of the county, form some of the most fertile agricultural lands in the nation. At higher elevations, sandy loams support forests valuable for timber production, recreation, and as a wildlife habitat. Sand from Scotts Valley and the Wilder Creek area is exported for glass production.

Santa Cruz County is well known for having some of the southernmost redwood forests. Douglas fir and Pacific ponderosa pine are also dominant forest types. Other vegetation in the county consists of plants belonging to the coastal scrub-chaparral plant community, the riparian plant community, and the agricultural plant community (Reference 4).

Many of the grasses, shrubs, and low-growing trees belonging to the coastal scrub-chaparral community are drought resistant and inhabit the foothills and low-rolling hills near the coast.

The riparian plant community occupies the banks of streams and lakes and is characterized by dense stands of deciduous trees and shrubs. California laurel, oak, willow, maple, elm, and locust are a few of the many trees belonging to this group.

The agricultural plant community includes orchards and cultivated row crops. The Pajaro Valley is the most important area of the county agriculturally. The native grassland has been largely replaced by apples, lettuce, strawberries, and other row crops.

The major drainage basins in the county are the San Lorenzo River, Soquel Creek, Aptos Creek, and Pajaro Valley basins.

The largest basin contained within the county is the San Lorenzo River basin which is located in central Santa Cruz County. This basin covers approximately 137 square miles and extends approximately 20 miles north from the river mouth into the coastal mountains. Basin elevations range from sea level at the City of Santa Cruz to over 3,000 feet National Geodetic Vertical Datum (NGVD) in the Santa Cruz Mountains. The lower 3 miles of the river flow through the City of Santa Cruz. Above Santa Cruz, the basin is primarily a resort area and includes both summer and permanent residences. In the unincorporated areas of the basin, the principal centers of population are Felton, Ben Lomond, and Boulder Creek.

The Soquel Creek basin is southwest of the San Lorenzo River basin and encompasses 43 square miles. It is triangular in shape, having a width of approximately 1 mile near the ocean and widening to approximately 12 miles in the upper portion of the basin. In the upper reaches, the terrain is steep and heavily forested, but changes to terraces and rolling hills near the ocean at Capitola.

The Aptos Creek basin is a small coastal basin covering approximately 24 square miles in south-central Santa Cruz County. The basin extends inland approximately 7 miles and increases in elevation from sea level in the Town of Aptos to approximately 2,500 feet NGVD along the northern basin boundary. The basin is very sparsely populated except near the mouth at Aptos where the terrain is relatively flat.

The Pajaro River drainage basin encompasses an area of approximately 1,300 square miles. The Pajaro Valley, a subbasin of the larger drainage basin, is triangular in shape, formed by the western slope of the Santa Cruz Mountains, and comprises approximately 112 square miles. The major communities in the Pajaro Valley are the City of Watsonville, and the Towns of Corralitos, Freedom, Pajaro, and

Watsonville Junction. Like the other drainage basins, elevations extend from near sea level at the mouth to approximately 2,800 feet NGVD at the mountain ridges. Gently sloping plains extend from the foot of the hills to the mouth at the Pacific Ocean. The mountainous areas are drained tributaries and are more heavily forested. The foothills are covered with shrubs, grass, and scattered trees; while the valley extending from the foothills to Monterey Bay contains mostly row crops and orchards. The economy of the Pajaro Valley is supported primarily by agriculture and related industries.

The New Brighton State Beach study area borders Monterey Bay and encompasses two coastal areas known as Pot Belly Beach to the west and Las Olas Shoreline Drive to the east. Pot Belly Beach gently rises from the coast to a low beach cliff. Approximately 15 homes have been constructed at the base of the cliff. Along the southern reach of the study site, 27 homes front the flood plain terrace.

The Seacliff State Beach study area is located 80 miles south of San Francisco. The unincorporated communities of Aptos and Rio Del Mar border Monterey Bay along Seacliff State Beach. Seasonal residents and tourists contribute an additional influx during the summer.

The study site faces southwest to the northern portion of Monterey Bay. Waves from the southwest have caused recent flood damage.

The beach has a long linear configuration that gives rise to a 20- to 30-foot high sandstone cliff. The coastline is smooth along most of its length; the exceptions being where Aptos Creek and unnamed drainages have incised portions of the cliff.

The communities which neighbor the study site are residential with a moderate segment of seasonal inhabitants. Local community services provide a portion of the economic base. The majority of wage earners commute 30 miles to industries in nearby San Jose.

Development within the flood plain consists of numerous luxury homes. No future developments are known at this time.

The Sunset State Beach study area is a stretch of beach that lies at the southwestern corner of Santa Cruz County. The beach is backed by coastal dunes called the Pajaro Dunes. This young dune field extends several miles north along the coast from the mouth of the Pajaro River and consists of a series of closely spaced, overlapping parabolic dunes less than 12 feet high. The Watsonville Slough borders the eastern side of the dunes.

Presently 396 condominiums, 24 townhouses, and 145 single-family dwelling occupy the dune area. Recent historical records indicate that a typical cycle consists of periodic erosion and inundation

of the dunes followed by renewed dune formation. Lateral scour of the river or overtopping by the surf or a combination of the two has been documented prior to the construction of the existing development.

In anticipation of potentially destructive events and in response to past storm and high-tide episodes, considerable protective measures have been installed at Pajaro Dunes. Approximately 20 percent more of the dunes are proposed for further development (Reference 5).

2.3 Principal Flood Problems

The wet season in Santa Cruz County generally extends from October through May, but most flooding has occurred from December through March. In all streams, but the Pajaro River, floodflow stages can rise from normal flow to extreme flood peaks in a few hours with high velocities in the main channels. Flood peaks at the lower end of the Pajaro River, however, occur approximately 24 hours after the flood-producing rainfall, mainly because of its large drainage area (Reference 6). Flooding is most severe when antecedent rainfall has produced saturated ground conditions.

Flooding has occurred in Santa Cruz County at various times throughout the last 100 years including December 1937, February 1940, December 1955, April 1958, and January 1982. The most significant floods occurred in 1955 and 1982 (References 6, 7, 8, 9, and 10).

In the San Lorenzo River basin, a total of $8.7 million damage resulted from intense rainfall during December 21 through 24, 1955, with $7.6 million damage occurring in the City of Santa Cruz (Reference 11). The most extensive damage in the county occurred in the Felton, Ben Lomond, and Boulder Creek areas where over 300 people were displaced or evacuated. At Ben Lomond, the San Lorenzo River remained above its banks for 83 hours (Reference 11). Severe local flooding occurred because of logjams that diverted high-velocity flows damaging bridges, private developments, and other lands. A total of 1,765 acres was flooded and two lives lost in the county portion of the basin (Reference 11). The estimated peak discharge for the San Lorenzo River at the Big Trees gaging station was 30,400 cubic feet per second (cfs) which corresponds to a recurrence interval of approximately 30 years.

The Soquel Creek basin, particularly the Town of Soquel, also experienced major flooding in December 1955. A major logjam occurred at the Soquel Avenue bridge causing a severe backwater condition. In Soquel, eight city blocks were inundated displacing 350 persons (Reference 11). Just upstream of the confluence with Hinckley Creek, floodwaters in the overbanks reached depths of 5 to 6 feet. Total damage in the Soquel Creek basin was estimated at $831,000 (Reference 11). The estimated peak flow for Soquel

Creek at the Soquel gage was 15,800 cfs which corresponds to a recurrence interval of 70 years.

In the Aptos Creek basin just east of the Soquel basin, only minor damage resulted from the December 1955 storm (Reference 11). A total of 140 acres of land was inundated by floodwaters which caused $62,000 in damage. Four homes along Moosehead Drive experienced flooding, while the Valencia Road crossing was heavily damaged. Other bridges receiving minor damage included the bridge on Aptos Creek, just south of the confluence with Valencia Creek, and the Southern Pacific Railroad bridge (Reference 7).

During December 21 through 24, 1955, and April 2 through 4, 1958, the Pajaro Valley experienced flooding. These floods are the two largest on record for the Pajaro River. The associated discharges for these events were 24,000 cfs and 23,500 cfs, respectively, at the Chittenden gage (Reference 6). The estimated recurrence intervals for floods of these magnitudes are 27 years and 26 years, respectively. In comparison, the estimated discharge at Chittenden for a 100-year flood is 43,000 cfs.

In the December 1955 flood, the Pajaro River was maintained within the levees in the Watsonville area, but the levees were breached 2.1 miles upstream of the confluence with Salsipuedes Creek (Reference 6). Although no lives were lost, 972 people were evacuated and $1.12 million damage incurred. Included in these costs were monies spent to repair levees damaged by erosion. Additional levee repairs were required because of the April 1958 flood; however, no other significant damage resulted (Reference 6).

Significant flooding along Corralitos and Salsipuedes Creeks also occurred in December 1955 and April 1958. Peak discharges for Corralitos Creek at Green Valley Road have been estimated from high-water elevations (Reference 11). The estimated discharges for the 1955 and 1958 floods are 3,620 cfs and 2,680 cfs, which correspond to recurrence intervals of 12 and 7 years, respectively. The overflow of Corralitos Creek upstream of the leveed section on Salsipuedes Creek flooded 29 blocks within the City of Watsonville during the December 1955 flood (Reference 6).

The Pajaro Valley experienced only minor damage from the January 1982 flood. The major impacts from this storm were felt in the San Lorenzo River, Soquel Creek, and Aptos Creek basins.

The magnitude of the January 1982 flood along the San Lorenzo River was similar to the December 1955 flood. At the Big Trees gage, a peak discharge of 29,700 cfs was measured which corresponds to a recurrence interval of approximately 30 years. The City of Santa Cruz was not inundated as in 1955 because of the protection afforded by the levees, but damage upstream of the City of Santa Cruz along the San Lorenzo River was extensive. The damage was most extensive

in the area between the upstream corporate limits and Felton, and in the Towns of Paradise Park, Gold Gulch, and Felton Grove. In the Felton Grove area, floodwaters in the overbanks reached depths of 3 to 7 feet and inundated 50 homes and cabins. An additional 60 to 70 homes and businesses were flooded between Felton and Ben Lomond (Reference 12).

During the January 1982 flood, the Soquel Creek basin experienced major flooding in the vicinity of the Soquel Avenue bridge. A massive logjam, which included a four-bedroom house and four auto-court apartments, diverted flow down the main street of the Town of Soquel (Figures 2 and 3). The floodwaters rose rapidly along Soquel Creek and caused major damage to two mobile home parks adjacent to the stream (Reference 12). The USGS estimate for the peak discharge at the Soquel Creek gage was 9,700 cfs. The estimated recurrence interval for this discharge was approximately 15 years.

Similar flooding was experienced in the Aptos Creek basin. The estimated peak discharge on Aptos Creek on January 3, 1982, was 3,950 cfs, in contrast to the December 1955 peak flow of 3,500 cfs. The 1982 peak flow corresponded to a 40-year recurrence interval, as measured at the Aptos gage. Heavy damage resulted from the 1982 storm. At least seven homes along Moosehead and Spreckels Drives between the State Highway 1 and Spreckels Drive bridges suffered major damage (Reference 12). Further downstream damage resulted to major portions of two streets paralleling Aptos Creek.

Flooding along the Pacific coast of Santa Cruz County is typically associated with the simultaneous occurrence of very high tides, large waves, and storm swells during the winter. As a result, ocean-front development has not been compatible with the natural instability of the shoreline and intense winter weather conditions.

Tsunamis (sea waves generated from oceanic earthquakes, submarine landslides, and volcanic eruptions) create some of the most destructive natural water waves. As tsunami waves approach shallow coastal waters, wave refraction, shoaling, and bay resonance amplify the wave heights.

Storm centers from the southwest produce the type of storm pattern most commonly responsible for the majority of serious coastline flooding. The strong winds and high tides that create storm surges are also accompanied by heavy rains. In some instances, high tides back up riverflows that causes flooding at the river mouths.

The most severe storms to hit the California coast occurred in 1978 and 1983 when high-water levels were accompanied by very large storm waves. The most notable events are described below.

Figure 2. January 1982 Logjam on Soquel Creek Which Caused Diversion of Flow (Santa Cruz Sentinel)

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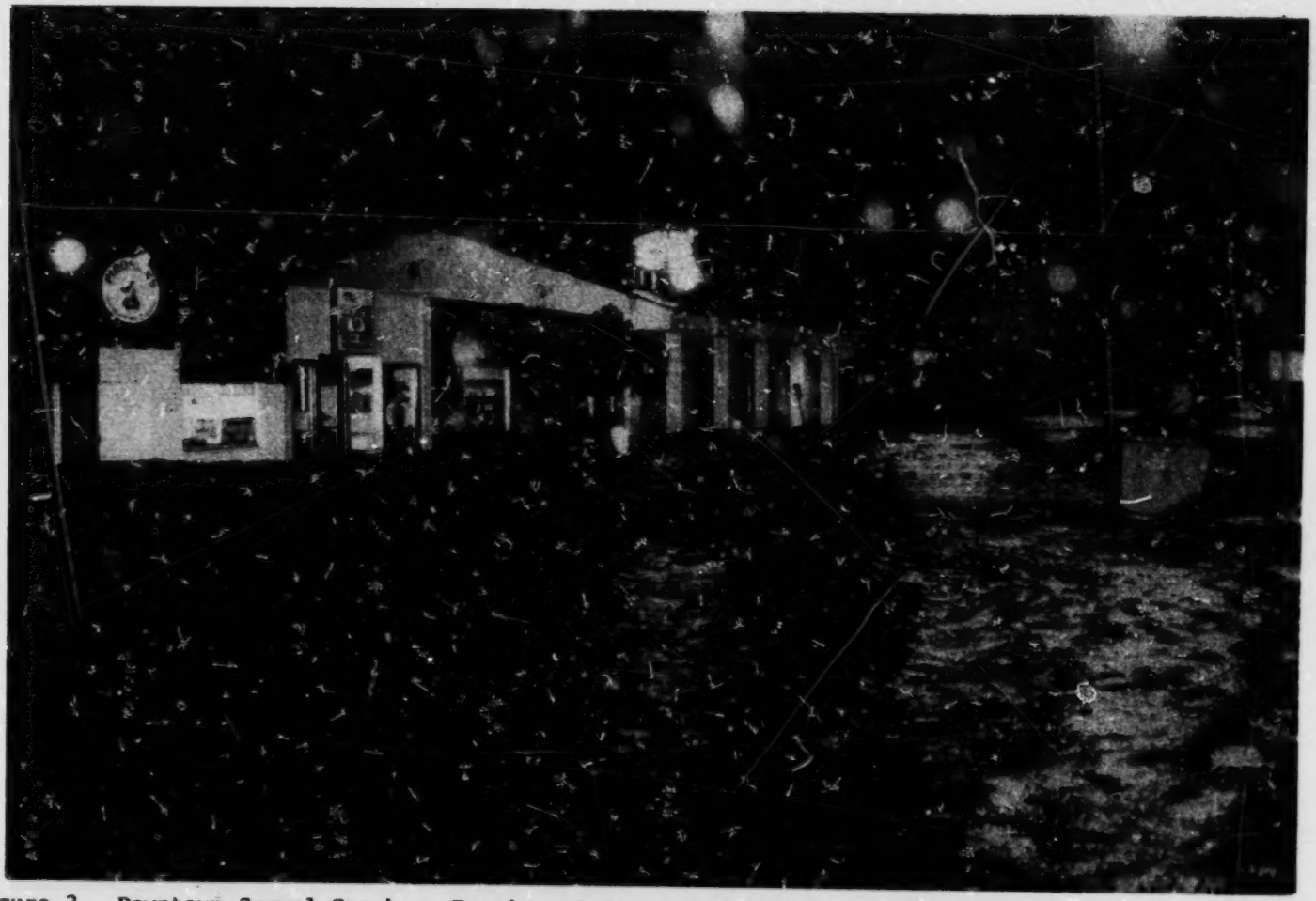

Figure 3. Downtown Soquel Creek on Evening of January 4, 1982 (Santa Cruz Sentinel)

In January 1978, a series of storms emanated from a more southerly direction than normally occurs; ccnsequently, some of the more protected beaches were also damaged. Storm incidents occurred throughout the study area.

Jetties and breakwater barriers were overtopped and in some cases undermined. Direct wave damage occurred to many beachfront homes, especially in the more populated beachfront areas along Monterey Bay. Accelerated erosion coupled with rain and saturated ground conditions weakened the foundations of beach-bluff top homes at Seacliff State Beach. Seawalls and temporary barriers failed to protect beachfront properties from the ravages of the 1978 storms.

Significant storms and associated damage strike the Monterey Bay communities with a frequency of one large storm every 3 to 4 years. The New Brighton and Seacliff State Beach study areas are directly exposed to storm waves which approach from the west, west-southwest, and southwest across deep waters. The waves undergo little refraction before striking the coastline. Statistics show that 13 out of 20 large storms arrive from the southwest.

Repeated damage has occurred to beachfront structures in an area of the coast between the New Brighton State Beach and Seacliff State Beach study sites. Approximatley every 7 years, seawalls or bulkheads at Seacliff State Beach are damaged or destroyed. The last episode occurred in 1983 when 3,500 feet of new seawall, a restroom, and 11 recreational vehicle sites were destroyed, which amounts to $740,000 in damage. In the Seacliff State Beach area, numerous homes have been constructed on fill to raise the height of the backbeach. In 1983, an existing protective riprap was overtopped and 19 of 21 homes were significantly damaged.

Much of lower Monterey Bay is bordered by the Pajaro Dunes area, which is a series of older stabilized dunes fronted by younger active dunes. Since 1882, structures which have been constructed in the area (Camp Goodall, 1883; 1,700-foot-long wharf, 1911) were partially destroyed by storm waves. Planned lot developments have been subject to rapid beach retreat several times prior to 1968, in 1969, in 1978, and again in 1983 (Reference 5).

2.4 Flood Protection Measures

Flood protection measures implemented in the unincorporated areas of Santa Cruz County have included nonstructural and structural measures. The nonstructural measures include flood plain zoning ordinances that regulate building within the flood plain. Structural measures implemented in the county have been limited primarily to the Pajaro Valley.

Flows in excess of approximately 10,000 cfs caused flooding on the lower Pajaro River before completion of the Federal levee project

(Reference 6). After the floods of 1938 and 1941, the COE designed levees for the Pajaro River and Salsipuedes Creek.

Levees were completed along the Pajaro River by the COE in 1949. Levees along the north bank begin just upstream of the mouth at the Pacific Ocean and continue to approximately River Mile 11.8 (Murphy Road); levees along the south bank begin just upstream of the mouth and continue to River Mile 10.6. The levees increased the capacity of the Pajaro River to 22,000 cfs downstream of Salsipuedes Creek, equivalent to a 25-year flood. In the same year, levee construction on Salsipuedes Creek from the confluence with the Pajaro River to River Mile 2.5 on the west bank to River Mile 1.7 on the east bank was also completed (Reference 6). The addition of the levees increased the capacity of Salsipuedes Creek to 10,000 cfs (Reference 6).

In 1963, the COE performed additional studies and recommended that the levees along the Pajaro River and along Salsipuedes and Corralitos Creeks be modified to provide additional protection (Reference 6). Construction was authorized in the Flood Control Act of 1966 and the project proceeded to the advanced stages of design, but local support in Watsonville was withdrawn and the project was placed in a deferred status (References 13 and 14).

No major flood control projects have been constructed in the Aptos Creek, Soquel Creek, or the Santa Cruz County portion of the San Lorenzo River basins. Local interests have provided noncontinuous bank protection constructed of various materials including concrete, timber, and riprap. A multiple-purpose reservoir on Soquel Creek, approximately 5 miles upstream from Monterey Bay, was found to be economically justified, but has not been implemented. A major flood control project, which includes levees and channel improvements, was constructed on the San Lorenzo River. These improvements, however, are located within the Santa Cruz City limits and not in the unincorporated portion of the county.

Residents and municipalities of northern Monterey Bay have spent hundreds of thousands of dollars on flood protecton measures to prevent coastal flood damage. Permanent structures such as seawalls, boulder-sized riprap, timber, and concrete bulkheads have been installed. Severe storms in January of 1983 overtopped many of the structures. Protection varied by site. At Seacliff State Beach, repeated storms have destroyed reconstruction efforts, while at New Brighton State Beach, damage was minor.

At Seacliff State Beach in January 1983, high waves associated with high tides overtopped a rock rubble mound to cause major damage to 19 of 21 homes. Of the 9.5 miles of northern Monterey Bay coastline, over half is protected by seawalls or riprap.

Southern Monterey Bay along the Pajaro Sand Dunes is susceptible to active dune retreat and deposition. Beach stabilization consists of a revegetation program between developed areas (Reference 5).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

Flood hazards along the coast of northern California may be generated by swell waves from offshore storms, by wind waves from land-falling storms, or by tsunami. The degree of hazard depends upon the water-surface elevation of the astronomical tide at the time of wave or tsunami occurrence. To evaluate the flood hazards for Santa Cruz County, detailed engineering studies separately defined the runup magnitude and frequency of astronomical tide-plus-swell waves arriving from both northwest and southwest directions, the runup magnitude and frequency of tide-plus-wind waves arriving from both northwest and southwest direction, and the magnitude and frequency of tide-plus-tsunami. These magnitude and frequency relations were statistically combined to provide a comprehensive evaluation of the coastal flood hazard for Santa Cruz County.

Details of the engineering analyses are provided in Reference 5, and a summary of the analyses is presented in Section 3.3.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

Peak floodflows for the 10-, 50-, 100-, and 500-year events were determined using two different methods. For the Pajaro Valley streams, peak flows were based on rainfall-runoff computations using the COE HEC-1 computer model (Reference 15). For all other drainage basins, peak discharges were determined from a regional regression analysis because these basins had little or no impoundment storage or regulation.

Calibration of rainfall-runoff parameters employed in the HEC-1 computer model was performed using the techniques described in the HEC-1 user documentation (Reference 16). For calibration, three basins were defined to coincide with the areas tributary to the three existing stream gages (Table 2). Precipitation records for the storms of January 29, 1963; December 21, 1964; January 20, 1967; January 18, 1969; and January 14, 1970, were used to generate basin rainfalls. The Thiessen polygon method was used to distribute rainfall over each basin. Using the Clark unit hydrograph method, basin parameters corresponding to the recession constant, time of concentration, and loss rate were determined by iterative parameter optimization. The values of the recession constant and time of concentration were then related to physical basin characteristics, permitting application of the model to ungaged locations. Using the two gages on Corralitos Creek and recorded data for two of the historical storms, Muskingham routing coefficients were determined.

Physical characteristics and the relationships developed during calibration were used to derive Clark unit hydrograph parameters for all subbasins defined for this study. Hypothetical 10-, 50-, 100-, and 500-year rainfall hyetographs were developed using published intensity-duration frequency curves (Reference 17). These rainfall patterns were used as input to the composite model of all subbasins. Initial loss rates were adjusted until peak flows at the three gaged locations equaled the 10-, 50-, 100-, and 500-year peak flows estimated by the USGS (Reference 18).

Flood hydrographs on the Pajaro River are influenced by storage and routing conditions in the overbanks. A flood hydrograph for the Pajaro River was obtained from the Interim Report for Flood Control, Pajaro River Basin, California (Reference 6). This hydrograph was scaled to give peak flows corresponding to those developed by the COE in an unpublished local drainage study for the area within the Pajaro River basin. These floodflow estimates account for upstream basin characteristics including regulated storage and are, therefore, more acceptable than the USGS estimates based solely on gaged flow records.

The method used for the regional regression analysis, which was applied to all basins but the Pajaro Valley, was developed by the USGS (Reference 18). The regression relationships predict peak floodflow for each average recurrence interval as a function of basin area, normal annual basin precipitation and average basin

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Table 2. Summary of Stream Gage Records Used in Pajaro Valley Hydrologic Analysis

Drainage	USGS Gage	Years of Record	Period of Record (Years)
Corralitos Creek Near Corralitos	11-1591.50	1958 to 1972	15
Corralitos Creek At Freedom	11-1592.00	1955 to 1979	22
Green Valley Creek Near Corralitos	11-1594.00	1961 to 1973	13

elevation. Other basin characteristics were found to be statistically insignificant for prediction of peak floodflows.

The regression relationships were calibrated using the most recent USGS log-Pearson Type III estimates of peak floodflows for 14 gaged streams in the immediate vicinity of the study area. USGS regional skew estimates (Reference 19) were used, rather than the Water Resources Council regional skew estimates, because the former values gave results that were more consistent for streams in the study area. The stream gages used to calibrate the regression relationships and their corresponding periods of record are given in Table 3. On gaged streams, peak flows generated from the regional regression analysis were adjusted to match the USGS log- Pearson Type III estimates at the gage. On ungaged streams, the peak flows generated from the regional regression analysis were used without adjustment.

For urbanized watersheds, results were adjusted to account for the effects of urbanization on peak floodflow. The adjustment for urbanization is a function of the percentage of basin developed and the percentage of channels for which storm sewers were constructed. The method of adjustment is described in Reference 18.

The resulting calibrated HEC-1 model and regression relationships were used to predict peak floodflows for all locations in the study area.

Peak discharge-drainage area relationships for streams studied in detail are shown in Table 4.

Analyses were carried out to establish the peak elevation-frequency relationships for each flooding source studied in detail.

Elevations for floods of the selected recurrence intervals on College Lake and Schwans Lagoon are shown in Table 5.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the riverine sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Water-surface elevations of floods of the selected recurrence intervals were computed for streams studied by detailed methods using the COE HEC-2 water-surface profile computer program (Reference 20).

Cross sections for all detailed analyses within Santa Cruz County were obtained from topographic maps provided by the COE (Reference 21) and orthophoto maps, developed from aerial surveys (Reference 22). The below-water sections were obtained by field measurement. All bridge and culvert dimensions and elevations required for detailed analysis were taken from field surveys or bridge and culvert plans. All plans used in this study were verified by field observation.

Table 3. Summary of Stream Gage Records Used in Regression Analysis

Drainage	USGS Gage	Years of Record	Period of Record (Years)
Aptos Creek At Aptos	11-1597.00	1959 to 1972	14
West Branch Soquel Creek Near Soquel	11-1598.00	1959 to 1972	14
Soquel Creek At Soquel	11-1600.00	1937, 1952 to 1975	25
San Lorenzo River Near Boulder Creek	11-1600.20	1969 to 1978	10[1]
Zayante Creek At Zayante	11-1603.00	1958 to 1978	21
San Lorenzo River At Big Trees	11-1605.00	1937 to 1978	42
Branciforte Creek At Santa Cruz	11-1615.00	1941 to 1943, 1953 to 1968	19
Majors Creek Near Santa Cruz	11-1615.70	1970 to 1976	7[1]
Laguna Creek Near Davenport	11-1615.90	1970 to 1976	7[1]

Table 3. Summary of Stream Gage Records Used in Regression Analysis (Cont'd)

Drainage	USGS Gage	Years of Record	Period of Record (Years)
San Vicente Creek Near Davenport	11-1618.00	1970 to 1978	9[1]
Scott Creek Above Little Creek Near Davenport	11-1619.00	1959 to 1972	14

[1]Log-Pearson Type III distribution parameters adjusted using two-station comparison (Reference 18) with gage number 11-1605.00

Table 4. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Aptos Creek					
Above Confluence With Valencia Creek	12.4	1,990	4,340	5,540	8,670
At Mouth	24.5	3,110	6,550	8,280	12,700
Arana Gulch					
At Mouth	3.3	790	1,390	1,650	2,290
Carbonera Creek					
At Southern Corporate Limits of the City of Scotts Valley	5.2	1,690	2,870	3,400	4,750
At Confluence With Branciforte Creek	7.2	2,250	3,680	4,340	5,900
College Lake					
At Confluence With Corralitos Creek	20.7	650	2,000	2,800	5,500
Corralitos Creek					
Above Confluence With Browns Creek	11.0	2,030	4,040	5,040	7,550
East Lake Avenue					
At Junction With Salsipuedes Creek	24.2	3,300	6,640	7,930	11,730
Coward Creek					
At Confluence With Pajaro River	3.2	310	480	660	1,250

Table 4. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Harkins Slough					
Above Confluence With Gallighan Slough	6.3	650	1,380	1,800	2,760
At Confluence With Pajaro River	9.8	860	1,920	2,540	4,140
Pajaro River					
Below Confluence With Salsipuedes Creek	1,275.0	14,250	32,500	43,600	76,200
Rodeo Creek Gulch					
At Mouth	3.0	790	1,290	1,540	2,130
Salsipuedes Creek					
At Confluence With Pajaro Creek	46.0	2,000[1]	4,500[1]	5,950[1]	12,500[1]
San Lorenzo River					
Below Confluence With Two Bar Creek	22.9	4,640	9,530	11,900	18,100
Below Confluence With Boulder Creek	51.2	9,390	18,800	23,400	34,800
Below Confluence With Love Creek	60.8	12,300	23,800	29,200	42,700
Below Confluence With Zayante Creek	106.0	18,800	35,000	42,600	60,700
At City of Santa Cruz Corporate Limits	116.0	21,700	39,300	47,200	66,100

[1]Discharge Loss Downstream of Corralitos Creek Occurs As Independent Overbank Flow

Table 4. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
San Vicente Creek					
At Mouth	11.3	1,240	2,340	2,860	4,140
Schwans Lagoon					
At East Cliff Drive	1.1	765	1,106	1,290	1,715
Soquel Creek					
Below Confluence With Hinckley Creek	31.8	4,510	8,270	10,000	14,200
Below Confluence With Moore's Gulch	34.6	7,410	13,400	16,100	22,600
Below Confluence With Bates Creek	40.2	8,080	14,400	17,200	24,000
Struve Slough					
At Confluence With Watsonville Slough	2.8	240	540	700	1,120
Thomasello Creek					
At Confluence With Pajaro River	3.6	370	590	850	1,560
Thompson Creek					
At Confluence With Pajaro River	5.3	520	700	1,000	1,870

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Table 4. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Watsonville Slough					
Below Confluence With Struve Slough	4.3	420	940	1,200	1,940
Below Confluence With Harkins Slough	15.6	1,320	2,980	3,910	6,400
At Confluence With Pajaro River	19.4	1,280[1]	2,940[1]	3,890[1]	6,580
Zayante Creek					
Below Confluence With Lompico Creek	14.3	3,820	6,420	7,580	10,300
Below Confluence With Bean Creek	26.1	6,150	9,990	11,700	15,500
At Confluence With San Lorenzo River	26.2	6,250	10,100	11,800	15,600

[1]Reduction in Flow Due to Overbank Storage

Table 5. Summary of Elevations

Flooding Source and Location	Elevation (Feet) 10-Year	50-Year	100-Year	500-Year
College Lake Northwest of State Highway 152	64.1	69.4	70.1	71.7
Schwans Lagoon	10.7	12.5	13.0	13.7
Lake Tynan	41.4	41.7	41.8	42.2

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and flood plain areas. Values ranged from 0.015 to 0.050 for the channels and from 0.045 to 0.10 for the overbank areas. The validity of roughness values for the Pajaro River was checked by comparing the computed water-surface profiles with those specified by the COE for the design discharge (Reference 6).

Starting water-surface elevations for most streams draining into the Pacific Ocean is mean higher high-water elevation. Those streams include Aptos Creek, the Pajaro River, Rodeo Creek Gulch, and the San Lorenzo River. The starting water-surface elevation for San Vicente Creek was determined by critical-depth computations. Starting water-surface elevations for Schwans Lagoon were based on manual computations which considered culvert and weir flow at East Cliff Drive.

Starting water-surface elevations for all other streams studied in detail were calculated using the slope-area method.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Because the Pajaro River levees do not provide 3 feet of freeboard with respect to the 100-year flood, water-surface elevations were computed for two cases. In the first case, flood elevations were computed before levee overtopping begins, assuming the levees remain intact. In the second case, floods were computed after overtopping occurs, assuming the levees had failed. According to FEMA guidelines, the worst case is used to establish flood elevations in the channel and in the flood plain area. In this study, water-surface elevations before levee overtopping were always highest for the channel, while the highest elevations for the flood plain area were computed when the levees were assumed to be overtopped. The location of levee failure cannot be predicted under major floods; therefore, it was assumed that all levees fail.

Profiles labeled "Pajaro River" represent channel elevations from the mouth at the Pacific Ocean upstream to the county limits. The extent of this coverage includes flood elevations both downstream and upstream of the levees, as well as channel elevations inside the levees, under the assumption that they are not overtopped.

Profiles labeled "Pajaro River - Without Consideration of Levee" represent overbank elevations that would occur by ignoring the existence of the levees. The profiles, therefore, extend from the downstream to upstream limits of overbank flooding, corresponding to the extent of the levees.

An elevated right bank on Thomasello Creek causes 100 cfs to be retained in the channel; however, during a 100-year flood, the creek flows over its elevated bank in a westerly direction and ponds at a lower elevation behind the Pajaro River levee.

The detailed hydraulic analysis of the Pajaro River after levee failure showed that overbank flooding west of the confluence with Thomasello Creek would be controlled by the Pajaro River before the combined overbank flows from the Pajaro River and Thompson and Thomasello Creeks cause deep ponding south of Riverside Road in the area bounded by an earthen berm along the east side of Thompson Creek and the northern levee of the Pajaro River. Floodflow in this area backs up to an average 6.5-foot depth. Overbank flow from Thompson Creek ponds on the north side of Riverside Road at depths less than 3 feet before weir flow occurs over the road to combine with the Pajaro River and Thomasello Creek overbank flows.

A similar situation exists northeast of the confluence of Salsipuedes Creek with the Pajaro River. The 100-year floodwaters overflowing the Pajaro River northern levee would combine with overbank flow from Coward Creek draining out of Lake Tynan to cause deep ponding. Floodflow in this area backs up against the outside of the Salsipuedes Creek levee to an average 6-foot depth.

A small deep ponding area occurs south of Riverside Road on the western side of Thompson Creek. Floodflow from Thompson Creek fills a depression to an average depth of 5 feet.

Sheetflow is shallow overland flooding generally less than 3 feet deep and unrelated to or not readily associated with channel flooding and flood profiles. Areas in Santa Cruz County subject to sheetflow were analyzed in this study.

Areas where overflow from channels or runoff in excess of storm drain capacity would collect and pond were also evaluated as part of shallow flooding investigations. The water-surface elevations of ponding in these areas were essentially independent of those along adjacent stream channels and were affected principally by obstructions in the flooded area. Shallow flooding areas were delineated using surveyed and photogrammetric elevations, field investigations by experienced engineers, and hand calculations based on normal depths.

Corralitos Creek overflows its southern banks northeast of the City of Watsonville during a 100-year flood. The breakout occurs

approximately 2,400 feet upstream of East Lake Avenue and causes shallow flooding less than 3 feet in depth. This flow crosses East Lake Avenue and enters the northeastern corner of Watsonville.

Areas of shallow sheetflow 1 foot in depth occur near Watsonville on the west overbank of the Pajaro River, adjacent to the levees. This flow would occur as a result of levee breaching during the 100-year flood event, as water leaving the channel crosses high ground before reaching lower areas in the overbank.

Areas of shallow sheetflow 1 foot in depth also occur northeast of Watsonville on the southern overbank of Corralitos Creek and adjacent to the western levee of Salsipuedes Creek.

Other shallow sheetflow areas occur on the western overbank of Coward Creek south of Riverside Road and on both sides of Thompson Creek between Carlton Road and Riverside Road.

Water-surface elevations on Watsonville Slough are influenced by those on the Pajaro River. Flood elevations on Struve Slough are determined by backwater elevations from the Pajaro River; therefore, no profiles are shown for Struve Slough.

Profiles for Rodeo Creek Gulch, San Vicente Creek, and Schwans Lagoon begin at the points where the 100-year flood elevations are equal to 5.7 feet. This point, which represents the approximate boundary between 100-year tidal surge and riverine flooding, is based on tide gage analyses by the COE (Reference 24).

Streams studied by approximate methods were analyzed using normal depth calculations, aerial surveys, and topographic maps supplied by the COE and Santa Cruz County (References 21, 22, and 23).

All elevations are referenced to the NGVD. Elevation reference marks used in this study are shown on the maps.

3.3 Coastal Flood Hazards

Swell-wave and wind-wave frequency and magnitude components were determined by a two-step process. The first step defined a "still-water elevation" that included effects of astronomical tide, storm surge, and wave setup. The second step determined wave runup above stillwater elevation onto the beach.

"Storm surge" is the super-elevation of water level above the astronomical tide elevation caused by the low barometric pressure and wind stresses of a strom. Storm surge was evaluated only for definition of the wind-wave component of land-falling storms. Setup is an additional super-elevation of water surface produced by wave action, and the magnitude of wave setup varies with wave character-

istics, bathymetry, and beach profile. Because wave setup varies with the characteristics of the waves, different stillwater elevations and magnitude relations were defined for wind waves from northwest, wind waves from southwest, swell waves from northwest, and swell waves from southwest. Wave runup is the maximum elevation of a wave breaking onto a beach and varies with wave characteristics, bathymetry, and beach profile.

Storm surge for Santa Cruz County was defined by a two-dimensional, finite-element computer model (Reference 26). Applicability of the model had been tested by using long-term climatic records for San Francisco (Reference 27) to synthesize a long-term record of storm surge hydrographs for San Francisco Bay. The close comparison of synthesized data with available tidal records confirmed the utility of the model for California storm conditions. For Santa Cruz County the model synthesized a record of storm surges from both the northwest and southwest quadrants based upon 1955 to 1983 data on windspeed, wind direction, and barometric pressures determined from North American Surface Weather Maps (Reference 28).

The effects of storm surge were combined with astronomical tide and wave setup to define the stillwater elevation needed to evaluate the wind-wave runup. Characteristics of astronomical tide at Santa Cruz County could be reliably defined from previous studies (Reference 29) and were convoluted with storm surge (Reference 30). The magnitude of wind-wave setup was calculated by an iterative process coupled with the wave runup calculations.

Runup of wind waves was evaluated by first determining the deepwater wave conditions from both the southwest and northwest quadrants using 1955 to 1983 climatic data in methods described in Reference 30. A wave track model (Reference 31) then transformed the deepwater waves as they traveled towards the shoreline on the basis of bathymetry and beach profiles. Beach transects along the coast provided a generalized representation of the beach profiles which control the magnitude of wave runup. In coastal study areas, beach transects were oriented perpendicular to the shoreline and were strategically located along shore to represent reaches with similar characteristics (see Figures 4, 5, and 6). Data were primarily obtained from offshore bathymetry maps supplemented with 1978 COE survey data (Reference 32). Table 6 provides a listing of the transect locations and Figure 7 represents a sample transect. The wave runup values along sloping sandy beaches were computed by Hunt's method (Reference 33) and at obstructions were computed by Stoa's method (Reference 34).

The elevation-probability distribution for swell waves followed a similar development. Stillwater was defined only from wave setup convoluted with astronomical tide. The frequency of offshore wave height and wave period from the northwest and southwest quadrants were determined from available data (Reference 35), and routed

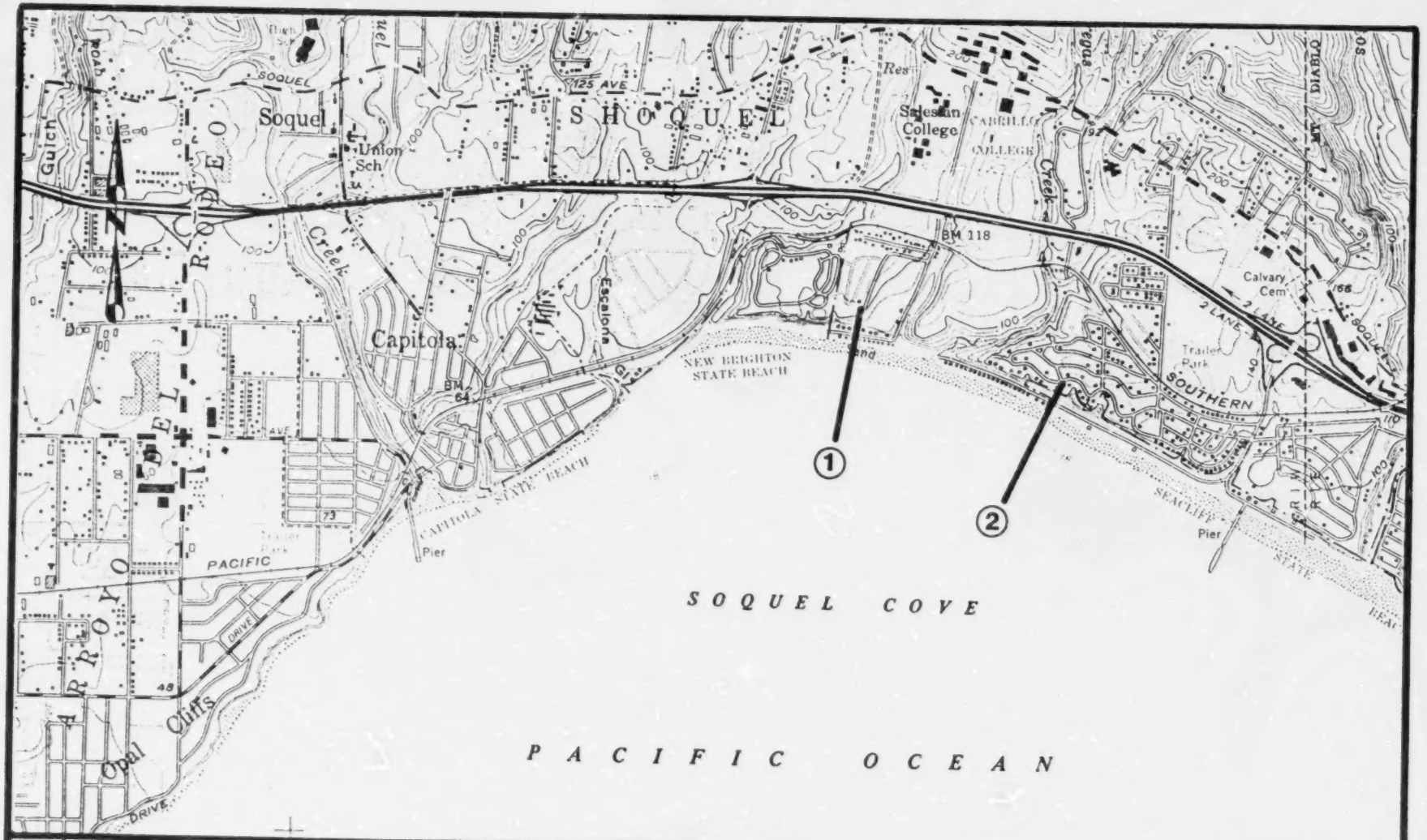

FIGURE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

APPROXIMATE SCALE IN FEET
1000 0 1000 3000 5000 7000

TRANSECT LOCATIONS
NEW BRIGHTON STATE BEACH

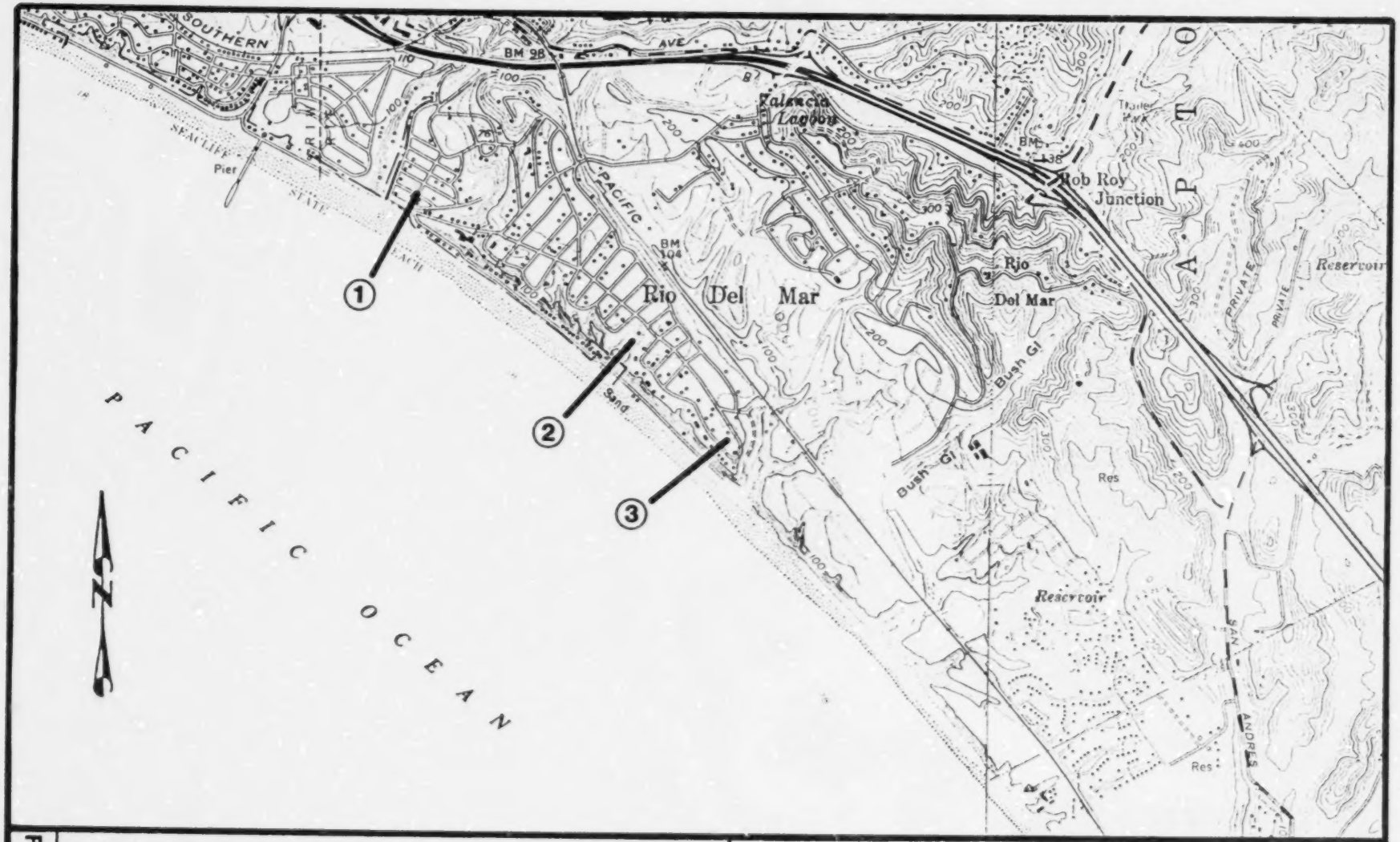

FIGURE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

APPROXIMATE SCALE IN FEET
1000 0 1000 3000 5000 7000

TRANSECT LOCATIONS

SEACLIFF STATE BEACH

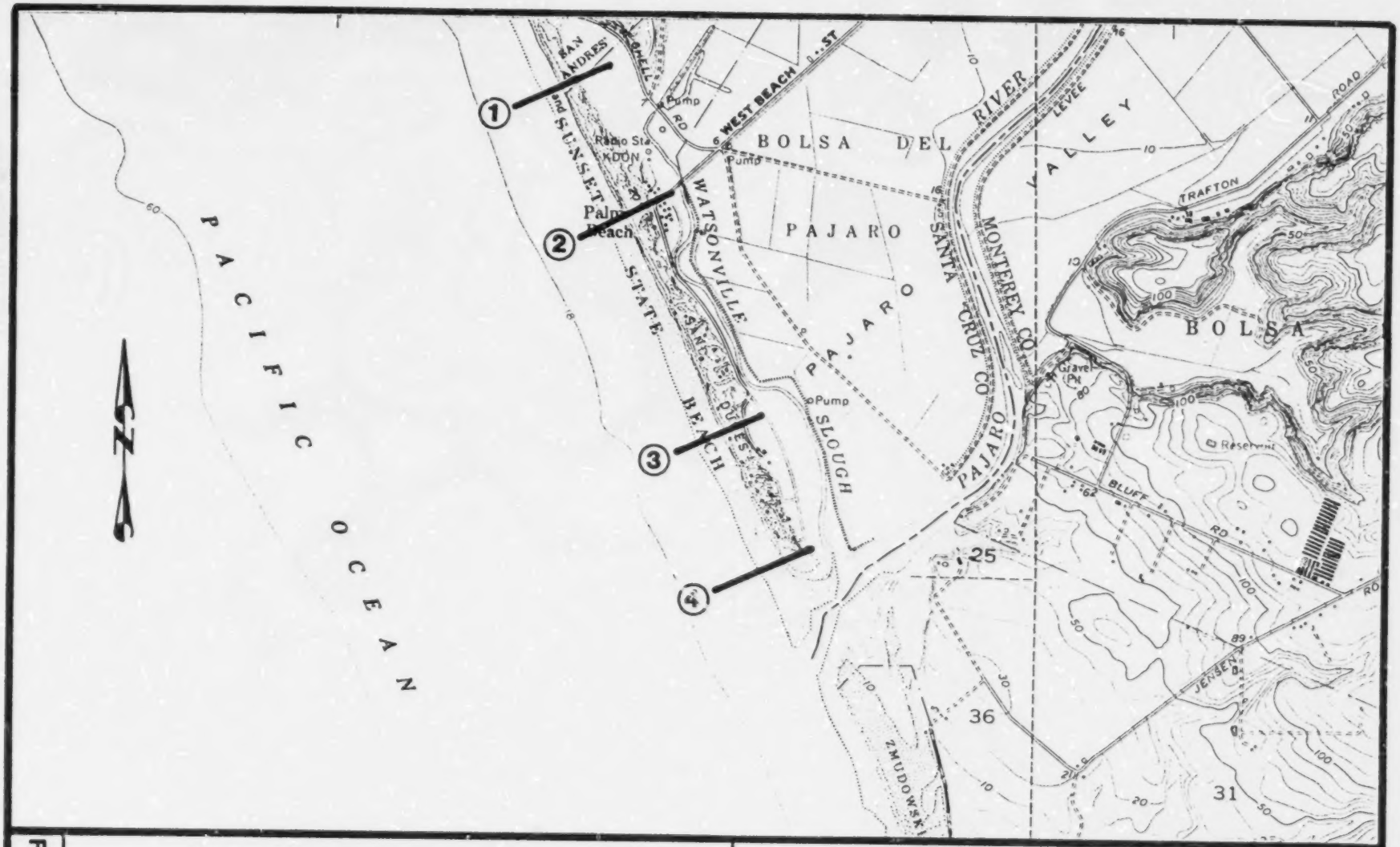

FIGURE 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

APPROXIMATE SCALE IN FEET
1000 0 1000 3000 5000 7000

TRANSECT LOCATIONS
SUNSET STATE BEACH

Table 6. Transect Locations

Study Area	Transect Number	Location
New Brighton State Beach	1	From the coastline 520 feet southeast of the Capitola city limits, and extending northeast to Pot Belly Beach Road
	2	West of Seacliff State Beach from the water's edge to a point northeast on Las Olas Shoreline Drive
Seacliff State Beach	1	From the coastline of Seacliff State Beach, 100 feet east of Aptos Creek, along Aptos Beach Drive in a northeasterly direction
	2	Northeast approximately 260 feet from the coastline of Seacliff State Beach to a point 800 feet southwest of Mirada Drive
	3	Upslope from the water's edge at a point south of the terminus of Beach Drive
Sunset State Beach	1	Approximately 2,200 feet north of West Beach Street, from the coastline of Sunset State Beach and east-northeast approximately 600 feet
	2	From the Sunset State Beach coastline east northeast to the parking lot at the terminus of West Beach Street
	3	From the Sunset State Beach coastline, northeast 720 feet to Rio Boca Road
	4	At the southern tip of Pajaro Dunes, from the coastline northeast to the Watsonville Slough

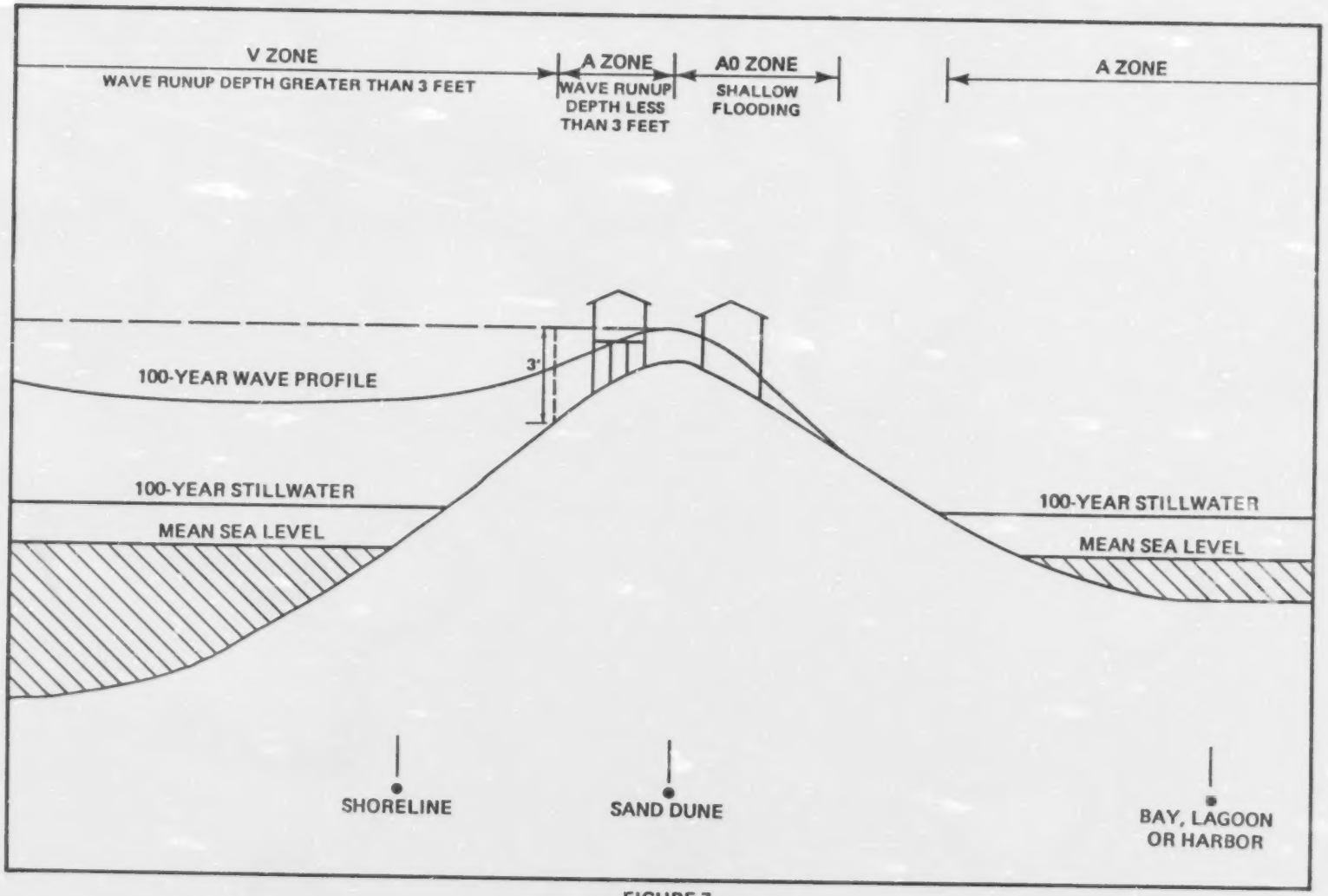

FIGURE 7
TYPICAL TRANSECT SCHEMATIC

shoreward with the wave tracking model. The runup elevation at each beach transect was calculated using Hunt's and Stoa's methods.

Tsunami-plus-astronomical tide elevations having 100-year and 500-year recurrence intervals, have been published (References 36, 37, and 38); and for this analysis at Santa Cruz County, the complete mangitude-frequency relationship was defined from supporting data for those earlier studies.

The joint probability of wind waves from the northwest and southwest quadrants, swell waves from the northwest and southwest quadrants, and of tsunamis was defined on the assumption that the events are independent. Results of the analysis are shown in the Summary of Stillwater Elevations (Table 7).

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:1,200, with a contour interval of 2 feet (Reference 21), orthophotos developed from aerial surveys (Reference 22), and from topographic maps at a scale of 1:4,800, with a contour interval of 20 feet (Reference 23). Detailed-study reaches along the Pacific Coast were delineated using topographic maps at a scale of 1:4,800 with contour intervals of 4 feet developed from aerial photographs (Reference 25).

Approximate flood boundaries were delineated using topographic maps at a scale of 1:4,800, with contour intervals of 4 feet developed from aerial surveys (Reference 22), from topographic maps prepared by the COE (Reference 21), and from topographic maps provided by the county (Reference 23).

Approximate flood boundaries in some portions of the study area were taken from the Flood Hazard Boundary Map (Reference 30).

Table 7. Summary of Stillwater Elevations

Location	10-Year	50-Year	100-Year	500-Year
Pacific Ocean				
New Brighton State Beach	4.6	4.8	5.0	5.3
Seacliff State Beach	4.6	4.8	5.0	5.3
Sunset State Beach	4.5	4.7	4.8	5.0

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Flood boundaries for streams found to have 100-year flood plains less than 200 feet wide were not delineated on the Flood Boundary and Floodway Map.

4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal-conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 8).

For the Pajaro River, floodways were computed based on the lower 100-year elevations obtained assuming the levees fail. No floodway was computed between cross sections G and V due to the independent shallow flooding and ponding which occurs north of the levees in Santa Cruz County and Watsonville and also due to the shallow flooding south of the levee in Monterey County. In areas of shallow flooding, overbank flow was carried hundreds of feet from the channel and a floodway was not applicable.

A floodway was not computed for cross sections E through J on Corralitos Creek and cross sections K and L on Salsipuedes Creek because shallow overbank flow was divided from the channel flow. In the northern overbank of the Pajaro River east of Watsonville,

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Aptos Creek								
A	300	299[2]	903	9.1	12.0	12.0	12.2	0.2
B	1,120	350	2,240	3.7	16.7	16.7	17.4	0.7
C	1,580	205	1,360	6.0	17.5	17.5	18.4	0.9
D	1,980	168	1,343	6.1	19.2	19.2	19.6	0.4
E	2,115	143	1,445	5.7	21.3	21.3	21.3	0.0
F	2,750	61	657	12.5	22.1	22.1	22.4	0.3
G	2,910	61	771	10.7	24.2	24.2	24.9	0.7
H	3,110	90	1,083	5.1	26.2	26.2	26.9	0.7
I	3,610	58	481	11.4	26.2	26.2	27.2	1.0
J	3,660	22	272	20.1	28.8	28.8	28.8	0.0
K	5,340	65	858	6.4	42.0	42.0	42.5	0.5
Arana Gulch								
B	5,160	150[3]	1,447	1.1	13.3	13.3	13.3	0.0
C	6,245	150[3]	307	5.1	13.3	13.3	13.7	0.4
D	7,180	150[3]	383	4.1	20.3	20.3	20.7	0.4
E	7,590	55/25[4]	297	5.3	26.2	26.2	26.4	0.2
K	10,467	70[3]	465	2.6	42.9	42.9	43.3	0.4
L	10,564	70[3]	645	1.9	45.5	45.5	45.8	0.3
M	10,688	70[3]	484	2.5	45.6	45.6	46.1	0.5
N	10,922	100	2,641	0.5	65.1	65.1	66.0	0.9
O	11,640	150	3,259	0.4	65.1	65.1	66.0	0.9

[1]Feet Above Mouth at Pacific Ocean [2]Width Includes Area of Coastal Velocity Hazards
[3]Floodway Lies Completely Within City of Santa Cruz [4]Width/Width Within County

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

APTOS CREEK-ARANA GULCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Carbonera Creek At Santa Cruz								
E	2,540	75/40[2]	744	5.8	40.0	40.0	40.0	0.0
F	3,870	66/36[2]	495	8.8	43.5	43.5	43.5	0.0
G	4,970	65/35[2]	373	11.6	52.8	52.8	52.8	0.0
Carbonera Creek At Scotts Valley								
A	20,420	32	286	11.6	445.2	445.2	445.7	0.5

[1] Feet Above Confluence With Branciforte Creek

[2] Width/Width Within County

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

CARBONERA CREEK AT SANTA CRUZ-CARBONERA CREEK AT SCOTTS VALLEY

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Corralitos Creek								
K[2]	13,680				67.9			
L[2]	15,050				72.8			
M	16,410	144	834	9.5	78.5	78.5	79.0	0.5
N	17,410	149	1,196	6.6	82.7	82.7	83.4	0.7
O	18,610	142	1,167	6.8	85.4	85.4	86.4	1.0
P	21,090	109/13[3]	765	10.4	96.8	96.8	96.8	0.0
Q	23,540	99	833	9.5	105.7	105.7	106.3	0.6
R	23,680	97	853	9.3	107.5	107.5	108.1	0.6
S	24,740	100	981	8.1	111.8	111.8	112.5	0.7
T	24,880	88	997	8.0	112.6	112.6	113.0	0.4
U	28,310	215	1,377	5.8	124.6	124.6	124.6	0.0
V	28,430	212	1,475	5.4	125.2	125.2	125.2	0.0
W	29,450	128	889	8.9	128.0	128.0	128.7	0.7
X	31,850	98	820	9.7	139.4	139.4	140.4	1.0
Y	33,360	200	950	8.4	149.7	149.7	150.0	0.3
Z	33,480	200	1,046	7.6	150.2	150.2	150.8	0.6
AA	35,910	144	982	8.1	158.2	158.2	158.5	0.3
AB	37,630	80	894	8.9	166.5	166.5	167.1	0.6
AC	40,310	96	750	10.6	182.5	182.5	182.6	0.1
AD	40,480	139	1,546	5.1	190.8	190.8	190.8	0.0
AE	41,830	85	790	10.0	192.7	192.7	193.2	0.5
AF	43,910	107	1,065	7.5	204.1	204.1	204.6	0.5
AG	45,970	102	1,019	7.8	216.0	216.0	217.0	1.0
AH	47,610	80	537	14.8	222.4	222.4	222.4	0.0
AI	48,250	100	862	9.2	230.8	230.8	231.3	0.5
AJ	49,430	113	860	9.2	238.2	238.2	238.6	0.4

[1] Feet Above Confluence With Pajaro River

[2] No Floodway Computed

[3] Width/Width Within County

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

CORRALITOS CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Corralitos Creek (Cont'd)								
AK	49,560	119	655	12.1	240.2	240.2	240.2	0.0
AL	51,650	87	564	14.1	253.6	253.6	253.7	0.1
AM	52,550	93	829	9.6	264.5	264.5	264.5	0.0
Coward Creek/ Lake Tynan[2]								
A	1,314				39.5			
B	1,446				39.5			
C	2,590				39.9			
D	4,869				41.7			
E	4,992				41.8			
F	5,460				41.8			

[1] Feet Above Confluence With Pajaro River

[2] No Floodway Computed for This Stream

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

CORRALITOS CREEK-COWARD CREEK/LAKE TYNAN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Harkins Slough								
A	780	706	2,889	0.8	14.0	5.9[2]	6.7[2]	0.8
B	3,040	120	864	2.7	14.0	6.2[2]	6.9[2]	0.7
C	3,460	201	1,733	1.3	14.0	7.6[2]	8.4[2]	0.8
D	5,320	350	2,847	0.8	14.0	7.6[2]	8.5[2]	0.9
E	7,970	411	2,729	0.7	14.0	7.6[2]	8.5[2]	0.9
F	8,360	422	2,954	0.6	14.0	7.6[2]	8.5[2]	0.9
G	11,220	401	2,566	0.7	14.0	7.7[2]	8.7[2]	1.0
H	13,360	139	397	4.5	14.0	8.9[2]	9.6[2]	0.7
I	13,640	150	631	2.8	14.0	10.7[2]	11.2[2]	0.5
J	13,850	100	379	4.7	14.0	10.8[2]	11.3[2]	0.5
K	14,540	108	1,586	1.1	25.7	25.7	25.7	0.0
L	16,580	125	1,187	1.5	25.8	25.8	25.9	0.1
M	17,530	101	638	2.8	25.9	25.9	26.2	0.3
N	18,670	81	242	7.3	31.3	31.3	31.3	0.0

[1] Feet Above Confluence With Watsonville Slough

[2] Elevations Computed Without Consideration of Backwater From Pajaro River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

HARKINS SLOUGH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Pajaro River								
A	200	1,535/ 355[2,5]	4,419	9.9	8.6	8.6	8.6	0.0
B	2,840	4,570/ 4,390[2]	27,409	1.6	12.3	12.3	12.3	0.0
C	7,680	--[3]	--[3]	--[3]	15.5	15.5	--[3]	--[3]
D	10,440	--[3]	--[3]	--[3]	17.8	17.8	--[3]	--[3]
E	13,101	--[3]	--[3]	--[3]	19.7	19.7	--[3]	--[3]
F	13,219	--[3]	--[3]	--[3]	19.7	19.7	--[3]	--[3]
G	15,760	--[3]	--[3]	--[3]	21.4	21.4	--[3]	--[3]
H[4]	18,120				23.3			
I[4]	20,278				26.7			
J[4]	20,883				27.3			
K[4]	23,020				27.8			
L[4]	26,940				33.0			
M[4]	28,500				34.2			
N[4]	29,899				35.6			
O[4]	30,031				35.6			
P[4]	31,095				35.6			
Q[4]	31,285				36.0			
R[4]	34,575				37.5			
S[4]	36,240				39.4			
T[4]	38,560				41.7			
U[4]	39,440				42.1			
V[4]	43,100				44.4			
W	46,145	--[3]	--[3]	--[3]	47.7	47.7	--[3]	--[3]
X	48,395	--[3]	--[3]	--[3]	50.2	50.2	--[3]	--[3]

[1]Feet Above Mouth at Pacific Ocean [2]Width/Width Within County [3]Floodway Computed Without Consideration of Levee [4]No Floodway Computed [5]Width Includes Area of Coastal Velocity Hazards

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

PAJARO RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Pajaro River (Cont'd)								
Y	52,015	--[3]	--[3]	--[3]	54.2	54.2	--[3]	--[3]
Z	54,105	--[3]	--[3]	--[3]	56.8	56.8	--[3]	--[3]
AA	57,665	--[3]	--[3]	--[3]	59.7	59.7	--[3]	--[3]
AB	60,610	--[3]	--[3]	--[3]	62.1	62.1	--[3]	--[3]
AC	60,850	--[3]	--[3]	--[3]	62.1	62.1	--[3]	--[3]
AD	62,270	1,340/460[2]	7,784	5.5	62.7	62.7	62.7	0.0
AE	66,110	300/100[2]	4,152	10.4	65.4	65.4	65.9	0.5
AF	68,240	300/60[2]	4,099	10.5	68.5	68.5	69.2	0.7
AG	71,020	304/64[2]	6,052	7.1	74.4	74.4	74.7	0.3
AH	73,820	271/191[2]	5,692	7.6	77.8	77.8	78.1	0.3
AI	76,380	500/390[2]	6,064	7.1	79.9	79.9	80.4	0.5
AJ	79,237	393/233[2]	6,471	6.6	82.7	82.7	83.3	0.6
AK	79,362	447/210[2]	6,155	7.0	82.8	82.8	83.3	0.5
AL	82,020	500/60[2]	4,337	9.5	84.7	84.7	85.7	1.0
AM	84,440	203/90[2]	3,756	11.4	89.1	89.1	89.7	0.6

[1] Feet Above Mouth at Pacific Ocean

[2] Width/Width Within County

[3] Floodway Computed Without Consideration of Levee

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

PAJARO RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Pajaro River Without Consideration of Levee								
B	2,840	4,570/ 4,340[3]	27,409	1.6	12.3	12.3	12.3	0.0
C	7,680	5,116/ 4,036[3]	21,892	2.0	12.9	12.9	13.1	0.2
D	10,440	5,488/ 4,488[3]	28,165	1.5	13.4	13.4	14.0	0.6
E	13,101	5,350/ 4,200[3]	28,665	1.5	13.8	13.8	14.6	0.8
F	13,219	5,315/ 4,295[3]	29,269	1.5	13.9	13.9	14.7	0.8
G	15,760	5,422/ 4,932[3]	30,289	1.4	14.3	14.3	15.1	0.8
H[4]	18,120				14.5			
I[4]	20,278				14.6			
J[4]	20,883				19.8			
K[4]	23,020				20.3			
L[4]	26,940				22.9			
M[4]	28,500				24.0			
W	46,145	3,683/ 583[3]	18,408	2.3	43.0	43.0	44.0	1.0
X	48,395	2,700/ 220[3]	13,953	3.1	44.3	44.3	45.1	0.8
Y	52,015	2,200/ 1,600[3]	10,093	4.3	48.1	48.1	48.4	0.3

[1] Feet Above Mouth at Pacific Ocean Watsonville Slough
[2] Width on Map May Be Greater
[3] Width/Width Within County
[4] Due to Combined Floodway With No Floodway Computed

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

PAJARO RIVER WITHOUT CONSIDERATION OF LEVEE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Pajaro River Without Consideration of Levee (Cont'd)								
Z	54,105	2,100/ 1,620[2]	10,804	4.0	49.8	49.8	50.5	0.7
AA	57,665	2,400/ 850[2]	11,024	3.9	52.8	52.8	53.6	0.8
AB	60,610	1,375/ 575[2]	8,709	4.9	56.8	56.8	57.1	0.3
AC	60,850	1,320/ 520[2]	9,916	4.3	58.1	58.1	58.1	0.0

[1]Feet Above Mouth at Pacific Ocean

[2]Width/Width Within County

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

PAJARO RIVER WITHOUT CONSIDERATION OF LEVEE

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Rodeo Creek Gulch								
A	750	200	1,540	1.0	7.7	7.7	7.7	0.0
B	2,505	148	253	6.1	7.8	7.8	7.9	0.1
C	3,020	40	369	4.2	14.1	14.1	14.9	0.8
D	4,550	68	309	5.0	18.7	18.7	18.8	0.1
E	4,670	68	237	6.5	19.4	19.4	20.1	0.7
F	5,220	68	420	3.3	21.9	21.9	22.7	0.8
G	5,440	70	776	1.8	26.8	26.8	26.9	0.1
H	6,225	70	423	3.3	26.9	26.9	27.2	0.3
I	6,960	30	121	11.5	30.8	30.8	30.9	0.1
J	7,180	49	1,060	1.3	53.3	53.3	53.3	0.0
K	9,205	47	325	3.8	53.7	53.7	54.2	0.5
L	10,385	120	389	3.2	59.8	59.8	60.8	1.0
M	10,945	40	748	1.6	78.6	78.6	78.6	0.0
N	12,565	40	345	3.1	78.7	78.7	79.0	0.3
O	14,255	40	280	3.8	80.5	80.5	81.3	0.8

[1] Feet Above Mouth

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

RODEO CREEK GULCH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Salsipuedes Creek								
A	870	95/50[2]	962	6.2	37.0	32.9[3]	32.9[3]	0.0
B	1,070	96/46[2]	995	6.0	37.0	33.3[3]	33.3[3]	0.0
C	3,220	213/123[2]	1,230	4.8	39.0	39.0	39.4	0.4
D	5,330	139/89[2]	990	6.0	44.7	44.7	44.7	0.0
E[4]	6,450				46.0			
F[4]	7,930				50.0			
G[4]	9,420				56.0			
H[4]	12,010				62.0			
I[4]	12,610				63.0			
J[4]	13,480				67.9			

[1]Feet Above Confluence With Pajaro River

[2]Width/Width Within County

[3]Elevation Computed Without Consideration of Backwater From Pajaro River

[4]No Floodway Computed

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SALSIPUEDES CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
San Lorenzo River								
A	16,428	260	3,184	14.6	37.1	37.1	37.8	0.7
B	17,903	237	3,347	13.9	42.7	42.7	42.9	0.2
C	18,578	246	5,248	8.8	48.8	48.8	48.8	0.0
D	19,558	234	3,133	14.8	49.0	49.0	49.2	0.2
E	20,898	240	3,097	13.0	54.6	54.6	55.2	0.6
F	21,828	233	4,326	10.7	60.8	60.8	61.4	0.6
G	23,088	234	3,963	11.7	63.0	63.0	64.0	1.0
H	23,408	157	3,817	12.2	66.0	66.0	66.6	0.6
I	25,078	156	2,864	16.2	67.9	67.9	68.8	0.9
J	43,599	452	6,592	6.5	256.4	256.4	256.4	0.0
K	45,739	800	17,448	2.5	259.4	259.4	259.4	0.0
L	48,726	1,000	11,078	3.9	260.1	260.1	260.7	0.6
M	48,982	1,000	10,283	4.2	260.4	260.4	260.9	0.5
N	49,281	1,000	11,673	3.7	260.9	260.9	261.6	0.7
O	49,673	1,000	12,667	3.4	261.3	261.3	262.1	0.8
P	52,365	786	8,666	4.2	263.0	263.0	263.9	0.9
Q	52,640	481	4,670	7.8	263.2	263.2	263.9	0.7
R	53,321	241	4,353	8.4	264.5	264.5	265.5	1.0
S	53,455	178	3,968	9.2	265.5	265.5	266.3	0.8
T	54,713	156	2,165	16.9	266.4	266.4	266.5	0.1
U	55,783	137	3,033	12.0	275.2	275.2	275.2	0.0
V	57,098	134	3,349	10.9	278.5	278.5	278.5	0.0
W	60,048	205	4,801	7.1	283.9	283.9	283.9	0.0
X	61,998	160	2,900	11.7	285.3	285.3	285.3	0.0
Y	62,128	174	3,203	10.6	288.3	288.3	288.3	0.0

[1]Feet Above Mouth at Pacific Ocean

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAN LORENZO RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
San Lorenzo River (Cont'd)								
Z	63,265	163	3,091	11.0	289.6	289.6	289.6	0.0
AA	63,502	163	3,386	10.0	293.8	293.8	293.8	0.0
AB	65,308	159	3,127	10.9	295.6	295.6	295.6	0.0
AC	67,988	153	3,784	9.0	302.3	302.3	302.7	0.4
AD	68,095	153	3,835	8.9	302.6	302.6	303.0	0.4
AE	69,173	188	3,156	10.8	303.1	303.1	303.6	0.5
AF	70,113	309	6,000	5.7	307.2	307.2	307.2	0.0
AG	72,818	106	1,982	15.0	309.6	309.6	309.9	0.3
AH	75,455	258	4,380	6.3	319.0	319.0	319.1	0.1
AI	75,592	166	3,527	7.8	320.3	320.3	320.3	0.0
AJ	75,890	169	3,541	7.8	321.4	321.4	321.4	0.0
AK	76,087	186	2,478	11.2	321.4	321.4	321.5	0.1
AL	77,411	114	1,522	18.2	324.6	324.6	324.6	0.0
AM	77,548	124	1,949	14.2	331.3	331.3	331.3	0.0
AN	79,844	171	2,203	12.2	337.8	337.8	337.8	0.0
AO	81,084	183	1,898	14.2	345.2	345.2	345.4	0.2
AP	83,293	122	1,999	13.5	363.9	363.9	364.9	1.0
AQ	83,515	124	2,103	12.8	367.2	367.2	367.2	0.0
AR	84,779	168	2,139	12.6	371.6	371.6	371.7	0.1
AS	86,227	110	1,806	14.3	381.3	381.3	381.3	0.0
AT	86,342	114	1,958	13.2	384.2	384.2	384.2	0.0
AU	88,429	118	1,835	14.1	390.8	390.8	390.8	0.0
AV	89,273	121	1,338	19.3	397.2	397.2	397.4	0.2
AW	89,585	195	2,163	11.9	403.8	403.8	403.8	0.0

[1] Feet Above Mouth at Pacific Ocean

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAN LORENZO RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
San Lorenzo River (Cont'd)								
AX	92,159	181	3,225	7.5	415.4	415.4	415.4	0.0
AY	93,351	159	2,011	12.0	416.3	416.3	416.3	0.0
AZ	93,517	151	2,355	10.2	420.9	420.9	420.9	0.0
BA	95,354	168	1,851	13.0	424.9	424.9	425.0	0.1
BB	97,474	139	2,355	10.2	439.0	439.0	439.0	0.0
BC	99,559	146	1,708	14.1	444.6	444.6	444.8	0.2
BD	100,846	180	2,343	10.3	455.6	455.6	455.6	0.0
BE	100,976	180	3,339	7.4	459.9	459.9	459.9	0.0
BF	102,626	85	1,370	8.9	462.1	462.1	462.9	0.8
BG	103,736	99	1,825	6.7	465.4	465.4	465.8	0.4
BH	104,956	62	921	13.2	466.2	466.2	466.6	0.4
BI	105,176	64	1,062	11.5	468.5	468.5	469.0	0.5
BJ	108,646	67	729	16.7	479.6	479.6	479.6	0.0
BK	109,377	96	1,483	8.2	488.1	488.1	488.1	0.0
BL	109,595	103	1,577	7.7	491.7	491.7	491.7	0.0
BM	111,766	127	1,793	5.9	496.6	496.6	496.6	0.0
BN	112,766	58	670	15.7	497.4	497.4	497.4	0.0
BO	112,886	63	859	12.3	500.1	500.1	500.1	0.0
BP	113,526	140	2,062	5.1	503.7	503.7	503.7	0.0
BQ	113,651	138	1,880	5.6	503.7	503.7	503.7	0.0
BR	114,573	103	1,025	10.3	505.8	505.8	505.9	0.1
BS	114,789	91	1,132	9.3	507.9	507.9	508.0	0.1
BT	118,356	135	1,415	4.3	519.5	519.5	520.0	0.5
BU	121,138	96	861	7.1	533.5	533.5	533.5	0.0

[1]Feet Above Mouth at Pacific Ocean

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAN LORENZO RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
San Lorenzo River (Cont'd)								
BV	121,264	92	1,025	6.0	535.7	535.7	535.7	0.0
BW	122,016	97	621	9.9	541.1	541.1	541.1	0.0
BX	123,862	95	1,139	5.4	547.4	547.4	547.4	0.0
BY	123,973	95	1,117	5.5	547.5	547.5	547.5	0.0
BZ	125,349	56	480	12.8	551.2	551.2	551.2	0.0
CA	125,495	58	560	11.0	553.2	553.2	553.2	0.0
CB	126,980	34	386	14.4	560.8	560.8	561.7	0.9
CC	127,145	56	535	10.4	564.8	564.8	564.8	0.0
CD	127,570	47	497	11.2	566.8	566.8	566.8	0.0
CE	127,735	52	542	10.3	568.2	568.2	568.2	0.0
CF	128,659	55	750	7.4	572.2	572.2	572.8	0.6
CG	128,825	74	741	7.5	572.2	572.2	573.0	0.8
CH	130,517	69	447	11.2	579.9	579.9	579.9	0.0
CI	131,197	51	347	14.5	591.7	591.7	591.7	0.0
CJ	132,261	40	511	8.3	600.6	600.6	601.1	0.5
CK	132,442	66	732	5.8	606.2	606.2	606.3	0.1
CL	133,499	63	344	12.3	610.0	610.0	610.1	0.1
CM	134,459	48	408	10.4	620.7	620.7	620.7	0.0
CN	137,442	49	318	13.3	641.3	641.3	641.3	0.0
CO	138,233	34	257	16.5	653.5	653.5	653.6	0.1
CP	138,355	50	343	12.3	658.4	658.4	658.4	0.0
CQ	140,439	55	313	13.5	675.7	675.7	675.7	0.0
CR	141,389	42	330	12.8	687.8	687.8	688.5	0.7

[1] Feet Above Mouth at Pacific Ocean

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAN LORENZO RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
San Vicente Creek								
A	300	36	212	13.5	9.6	9.6	9.6	0.0
B	675	15	219	13.1	18.8	18.8	18.8	0.0
C	1,035	63	1,132	2.5	28.2	28.2	28.2	0.0
D	1,735	70	517	5.5	28.3	28.3	28.5	0.2
E	1,975	83	535	5.3	28.8	28.8	29.5	0.7
F	2,475	359	526	5.4	34.0	34.0	34.0	0.0
G	2,955	152	412	6.9	41.1	41.1	41.1	0.0
H	3,575	129	384	7.4	52.2	52.2	52.2	0.0
I	4,475	205	517	5.5	66.2	66.2	66.2	0.0
Schwans Lagoon[2]								
A	480				13.1			
B	540				13.1			
C	2,200				13.1			

[1] Feet Above Mouth at Pacific Ocean

[2] No Floodway Computed for This Stream

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SAN VICENTE CREEK-SCHWANS LAGOON

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Soquel Creek								
A	5,970	355	3,140	5.5	34.1	34.1	35.0	0.9
B	6,115	487	4,200	4.1	36.7	36.7	37.3	0.6
C	8,140	600	4,770	3.6	39.8	39.8	40.5	0.7
D	8,385	623	6,770	2.6	41.6	41.6	42.5	0.9
E	9,355	106	1,190	14.6	41.6	41.6	42.5	0.9
F	11,235	236	3,050	5.7	52.1	52.1	52.3	0.2
G	13,915	301	2,520	6.5	56.9	56.9	57.8	0.9
H	18,435	179	2,060	8.0	79.1	79.1	79.6	0.5
I	21,995	161	1,680	9.7	96.9	96.9	96.9	0.0
J	24,835	266	1,600	10.2	106.0	106.0	106.0	0.0
K	25,835	470	4,160	3.9	112.3	112.3	112.3	0.0
L	26,555	280	2,100	7.8	113.6	113.6	113.6	0.0
M	27,755	155	1,260	13.0	120.5	120.5	120.5	0.0
N	29,025	120	1,300	11.8	132.1	132.1	132.2	0.1
O	29,310	153	2,260	6.8	141.1	141.1	141.1	0.0
P	32,500	154	1,780	8.6	151.3	151.3	152.3	1.0
Q	32,970	93	1,070	14.2	154.6	154.6	154.6	0.0
R	33,085	92	1,420	10.8	159.0	159.0	159.1	0.1
S	34,825	132	2,290	6.7	168.9	168.9	169.9	1.0
T	36,825	141	1,820	8.4	175.2	175.2	176.2	1.0
U	38,025	108	1,390	11.0	186.2	186.2	186.2	0.0
V	38,135	114	1,610	9.5	188.7	188.7	188.7	0.0
W	39,735	110	1,742	8.8	196.2	196.2	196.6	0.4

[1] Feet Above Mouth at Pacific Ocean

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

SOQUEL CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Struve Slough								
A	800[1]	351/ 154[2]	874	0.8	14.6	3.6[3]	4.6[3]	1.0
B	1,700[1]	143	403	1.7	14.6	3.8[3]	4.7[3]	0.9
C	1,830[1]	102	409	1.7	14.6	4.2[3]	5.1[3]	0.9
D	3,130[1]	158	325	2.2	14.6	4.9[3]	5.9[3]	1.0
Thomasello Creek[5]								
A	1,040[4]				46.7			
B	2,080[4]				48.9			
C	3,038[4]				49.9			
D	3,322[4]				53.9			
E	4,260[4]				53.9			
Thompson Creek[5]								
A	1,190[4]				45.5			
B	2,610[4]				45.5			
C	3,978[4]				50.0			
D	4,121[4]				51.0			
E	5,540[4]				56.0			
F	7,208[4]				70.7			
G	7,332[4]				70.7			
H	8,460[4]				80.8			
I	11,100[4]				112.9			

[1]Feet Above Mouth [2]Width/Width Within County [3]Elevation Computed Without Consideration of Backwater From Pajaro River [4]Feet Above Confluence With Pajaro River [5]No Floodway Computed for This Stream

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

STRUVE SLOUGH-THOMASELLO CREEK-THOMPSON CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Watsonville Slough								
A	400	626[3]	2,725	1.4	10.2	8.7	8.7	0.0
B	1,680	791[3]	3,813	1.0	10.8	8.9	8.9	0.0
C	2,880	1,050[3]	4,230	0.9	11.2	9.0	9.0	0.0
D	3,920	847[3]	4,076	0.9	11.6	9.0	9.1	0.1
E	5,120	1,306[3]	6,262	0.6	12.0	9.1	9.2	0.1
F	6,220	800[3]	4,147	0.9	12.4	9.2	9.3	0.1
G	6,375	800[3]	2,862	1.4	12.7	9.2	9.3	0.1
H	7,680	1,150[3]	2,307	1.7	12.8	9.2	9.8	0.6
I	7,980	950[3]	5,869	0.7	12.9	9.2	9.8	0.6
J	9,090	942[3]	4,582	0.8	13.0	9.2	9.9	0.7
K	10,290	959[3]	4,343	0.9	13.1	9.3	10.0	0.7
L	11,770	950[3]	4,833	0.8	13.2	9.3	10.1	0.8
M	12,940	900[3]	4,268	0.9	13.4	9.4	10.2	0.8
N	14,220	900[3]	4,289	0.9	13.5	9.5	10.3	0.8
O	14,940	900[3]	4,103	0.9	13.8	9.5	10.3	0.8
P	15,180	750[3]	4,406	0.9	13.9	11.3	11.4	0.1
Q	17,915	100[3]	715	1.8	14.2	11.3	11.5	0.2
R	18,185	100[3]	796	1.6	14.2	12.1	12.1	0.0
S	22,420	100	922	1.4	14.6	12.1	12.6	0.5
T	23,830	30	215	1.9	14.7	12.1	12.8	0.7
U	24,065	30[4]	218	1.9	15.7	12.1	12.8	0.7
V	24,695	30	242	1.7	19.5	12.2	13.0	0.8
W	25,340	30	274	1.5	20.4	12.3	13.1	0.8

[1]Feet Above Confluence With Pajaro River [2]Elevations Computed Without Consideration of Influence From Pajaro River
[3]Width on Map May Be Greater Due to Combined Floodway With Pajaro River
[4]Floodway Lies Entirely Within City of Watsonville

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

WATSONVILLE SLOUGH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Watsonville Slough (Cont'd)								
X	26,190	30	159	2.6	21.2	12.5	13.3	0.8
Y	26,310	30	231	1.8	21.3	14.1	14.2	0.1
Z	27,150	30	194	2.1	23.0	14.2	14.6	0.4
AA	27,960	49	329	1.2	23.0	14.2	14.8	0.6
AB	28,080	50	392	1.0	23.0	14.2	14.9	0.7

[1]Feet Above Confluence With Pajaro River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

WATSONVILLE SLOUGH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Zayante Creek								
A	905	41	664	17.7	262.3	260.0[2]	260.0[2]	0.0
B	1,055	181	1,778	6.6	265.2	265.2	265.2	0.0
C	1,745	117	1,103	10.6	265.7	265.7	265.7	0.0
D	2,435	120	1,560	7.5	268.0	268.0	268.0	0.0
E	2,600	118	1,467	8.0	268.5	268.5	268.5	0.0
F	3,250	66	636	13.2	270.9	270.9	270.9	0.0
G	4,200	67	619	13.6	278.2	278.2	278.2	0.0
H	4,845	88	1,000	8.4	283.6	283.6	283.6	0.0
I	5,000	98	888	9.5	284.6	284.6	284.6	0.0
J	5,810	97	750	11.2	289.6	289.6	289.6	0.0
K	7,065	126	1,406	6.0	297.3	297.3	297.3	0.0
L	7,245	163	1,761	4.8	298.4	298.4	298.4	0.0
M	7,780	126	1,078	7.8	298.8	298.8	298.8	0.0
N	8,500	74	630	11.3	301.2	301.2	301.2	0.0
O	8,990	104	882	9.5	305.9	305.9	305.9	0.0
P	10,570	78	734	11.4	314.9	314.9	314.9	0.0
Q	11,150	86	899	9.3	319.5	319.5	319.5	0.0
R	11,730	70	811	10.3	321.7	321.7	321.7	0.0
S	12,080	64	636	12.3	322.9	322.9	322.9	0.0
T	12,790	64	528	14.9	328.6	328.6	328.6	0.0
U	13,140	89	612	12.8	333.0	333.0	333.0	0.0
V	13,260	83	714	11.0	336.1	336.1	336.1	0.0
W	14,830	92	741	10.6	345.7	345.7	345.7	0.0
X	16,250	88	745	10.5	353.6	353.6	353.6	0.0
Y	16,530	65	640	9.5	355.7	355.7	355.7	0.0
Z	16,840	53	390	15.5	357.0	357.0	357.0	0.0

[1] Feet Above Confluence With San Lorenzo River

[2] Elevation Computed Without Consideration of Backwater From San Lorenzo River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

ZAYANTE CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Zayante Creek (Cont'd)								
AA	17,500	77	486	12.5	369.0	369.0	369.0	0.0
AB	18,040	76	449	13.5	375.3	375.3	375.3	0.0
AC	18,580	86	558	10.9	381.9	381.9	381.9	0.0
AD	18,700	117	1,174	5.2	389.2	389.2	389.2	0.0
AE	18,930	110	954	6.3	389.4	389.4	389.4	0.0
AF	19,190	40	357	17.0	395.2	395.2	395.2	0.0
AG	19,840	89	800	7.6	402.4	402.4	402.4	0.0
AH	20,240	69	438	13.8	404.8	404.8	404.8	0.0
AI	20,650	88	739	8.2	410.2	410.2	410.2	0.0
AJ	20,770	70	621	9.7	410.5	410.5	410.5	0.0
AK	21,170	50	382	15.8	413.1	413.1	413.1	0.0
AL	21,560	62	433	14.0	420.2	420.2	420.2	0.0
AM	22,030	62	445	13.6	426.6	426.6	426.6	0.0
AN	22,490	56	475	12.7	431.8	431.8	431.8	0.0
AO	23,100	56	470	12.9	437.2	437.2	437.2	0.0
AP	23,700	27	313	19.3	447.8	447.8	447.8	0.0
AQ	24,230	32	486	12.4	458.7	458.7	458.7	0.0
AR	24,750	52	653	9.3	462.6	462.6	462.6	0.0
AS	25,930	65	643	9.4	467.3	467.3	467.3	0.0
AT	26,050	64	614	9.9	467.8	467.8	467.8	0.0

[1] Feet Above Confluence With San Lorenzo River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOODWAY DATA

ZAYANTE CREEK

flow leaves the channel in the Pajaro River tributaries and does not reenter. For Coward, Thompson, and Thomasello Creeks, floodways were not computed because the flow that escapes the channels cannot be contained within a floodway without incurring a rise in water-surface elevation of more than 1.0 foot.

Floodways for Struve Slough, Watsonville Slough, and Salsipuedes Creek were computed separately without consideration of backwater from the Pajaro River.

Watsonville Slough and the Pajaro River were found to have overlapping floodways south of Watsonville from approximately 1 mile south of State Highway 1 downstream to their confluence. Therefore, only one combined floodway is shown on the Flood Boundary and Floodway Map.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 8.

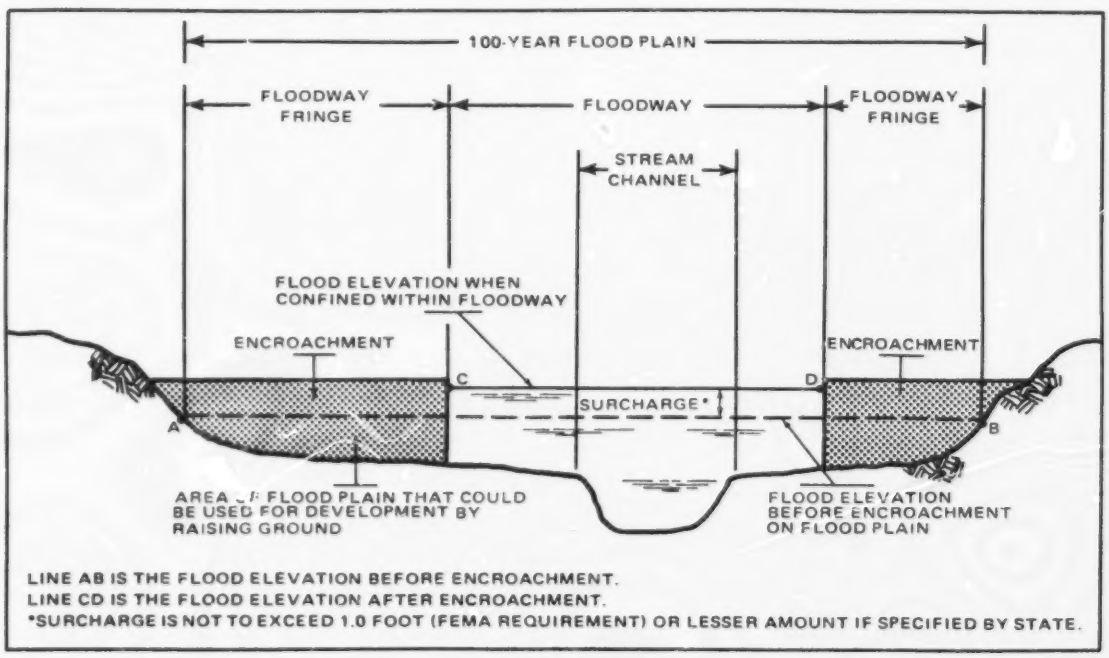
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Figure 8. Floodway Schematic

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting Santa Cruz County.

5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of Santa Cruz County are shown on the Flood Profiles (Exhibit 1) and summarized in Table 9.

Because overbank flow due to levee failure on the Pajaro River controls the water-surface elevation in Struve Slough and Watsonville Slough during major floods, these streams have the same insurance zone designations as the Pajaro River overbank and thus no data will be shown in the Flood Insurance Zone Data Table.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOCD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Aptos Creek							
Reach 1	0360	-3.9	-0.8	1.6	040	A8	Varies - See Map
Reach 2	0360	-6.2	-1.9	4.3	060	A12	Varies - See Map
Arana Gulch							
Reach 1	0355	-7.2	-1.8	0.8	070	A14	Varies - See Map
Reach 2	0355	-3.4	-0.8	0.9	035	A7	Varies - See Map
Reach 3	0355	-1.1	-0.2	0.5	010	A2	Varies - See Map
Reach 4	0355	-2.4	-0.3	0.7	025	A5	Varies - See Map
Reach 5	0355	-4.2	-0.7	0.7	040	A8	Varies - See Map
Reach 6	0355	-12.4	-0.2	0.5	120	A22	Varies - See Map
Carbonera Creek At Santa Cruz							
Reach 1	0340	-3.5	-0.9	2.0	035	A7	Varies - See Map
Carbonera Creek At Scotts Valley							
Reach 1	0220	-3.4	-1.2	3.6	035	A7	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

APTOS CREEK-ARANA GULCH-CARBONERA CREEK AT SANTA CRUZ-
CARBONERA CREEK AT SCOTTS VALLEY

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
College Lake							
Reach 1	0405,0415	-6.2	-0.7	1.6	060	A12	70
Corralitos Creek							
Reach 1	0385,0395 0405,0415	-4.1	-1.0	1.6	040	A8	Varies - See Map
Shallow Flooding	0415	N/A	N/A	N/A	N/A	AO	Depth 1
Ponding	0415	N/A	N/A	1.2	N/A	AH	Varies - See Map
Coward Creek/ Lake Tynan							
Reach 1	0415	-1.1	0.0	0.0	010	A2	Varies - See Map
Reach 2	0405,0415	-0.4	-0.1	0.3	005	A1	Varies - See Map
Shallow Flooding	0415	N/A	N/A	N/A	N/A	AO	Depth 1
Harkins Slough							
Reach 1	0395	-9.3	-6.2	18.4	095	A19	Varies - See Map
Reach 2	0395	-4.2	-3.2	18.4	040	A8	Varies - See Map
Reach 3	0385,0395	-2.4	-0.8	16.3	025	A5	Varies - See Map
Pajaro River Without Consid- eration of Levee							
Reach 1	0390,0395 0415,0420	-3.1	-0.9	2.0	030	A6	Varies - See Map
Shallow Flooding	0395	N/A	N/A	N/A	N/A	AO	Depth 1

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

COLLEGE LAKE-CORRALITOS CREEK-COWARD CREEK/LAKE TYNAN-HARKINS SLOUGH-PAJARO RIVER WITHOUT CONSIDERATION OF LEVEE

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Pajaro River							
Reach 1	0390	-1.3	-0.1	0.3	015	A3	Varies - See Map
Reach 2	0390,0395	-3.7	0.0	0.0	035	A7	Varies - See Map
Reach 3	0395,0415 0420	-7.7	-0.7	1.7	075	A15	Varies - See Map
Deep Ponding	0415	-6.0[4]	N/A	N/A	060	A12	37
Deep Ponding	0415	-6.5[4]	N/A	N/A	065	A13	45
Rodeo Creek Gulch							
Reach 1	0355	-2.5	-0.8	1.8	025	A5	Varies - See Map
Reach 2	0355	-1.3	-0.4	1.1	015	A3	Varies - See Map
Reach 3	0355	-3.0	-0.9	2.2	030	A6	Varies - See Map
Reach 4	0355	-8.6	-0.2	0.4	085	A17	Varies - See Map
Reach 5	0355	-2.7	-0.4	0.8	025	A5	Varies - See Map
Reach 6	0355	-1.3	-0.4	0.9	015	A3	Varies - See Map
Reach 7	0355	-8.4	-4.0	11.7	085	A17	Varies - See Map
Reach 8	0355	-5.8	-3.5	12.4	060	A12	Varies - See Map
Reach 9	0355	-3.2	-1.6	11.6	030	A6	Varies - See Map
Salsipuedes Creek							
Reach 1	0415	-4.1	-1.0	1.6	040	A8	Varies - See Map
Shallow Flooding	0415	N/A	N/A	N/A	N/A	AO	Depth 1

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot
[4]Elevation Difference Between Ground and 100-Year Flood

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

PAJARO RIVER-RODEO CREEK GULCH-SALSIPUEDES CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
San Lorenzo River							
Reach 1	0220,0340	-7.3	-2.4	2.4	075	A15	Varies - See Map
Reach 2	0215,0220	-10.4	-2.7	5.4	100	A20	Varies - See Map
Reach 3	0205,0215	-10.7	-2.9	6.3	110	A21	Varies - See Map
Reach 4	0095,0115 0205	-8.0	-2.3	4.9	080	A16	Varies - See Map
Reach 5	0085,0095	-5.1	-1.5	3.5	050	A10	Varies - See Map
Reach 6	0085	-4.1	-1.2	2.9	040	A8	Varies - See Map
San Vicente Creek							
Reach 1	0190	-7.5	-3.5	6.7	075	A15	Varies - See Map
Reach 2	0190,0195	-2.4	-1.0	2.3	025	A5	Varies - See Map
Schwans Lagoon							
Reach 1	0355	-2.3	-1.8	1.7	025	A5	Varies - See Map
Soquel Creek							
Reach 1	0355	-6.7	-1.7	2.9	065	A13	Varies - See Map
Reach 2	0240,0355	-4.8	-1.3	2.7	050	A10	Varies - See Map
Reach 3	0240	-5.6	-1.6	3.3	055	A11	Varies - See Map
Thomasello Creek							
Reach 1	0415	-0.7	-0.3	0.6	005	A1	Varies - See Map
Deep Ponding	0415	-6.5[4]	N/A	0.0	065	A13	45

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

[4]Elevation Difference Between Ground and 100-Year Flood

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

SAN LORENZO RIVER-SAN VICENTE CREEK-SCHWANS LAGOON-SOQUEL CREEK-THOMASELLO CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Thompson Creek							
Reach 1	0415	-4.4	-3.1	0.0	045	A9	Varies - See Map
Reach 2	0415	-0.4	-0.2	0.1	005	A1	Varies - See Map
Reach 3	0405,0415	-1.7	-1.0	2.1	015	A3	Varies - See Map
Shallow Flooding	0415	N/A	N/A	N/A	N/A	A0	Depth 1
Ponding	0415	N/A	N/A	N/A	N/A	AH	50
Deep Ponding	0415	-5.0[4]	N/A	0.0	050	A10	43
Deep Ponding	0415	-6.5[4]	N/A	N/A	065	A13	45
Zayante Creek							
Reach 1	0210,0215 0220	-4.2	-1.1	2.2	040	A8	Varies - See Map
Reach 2	0210	-5.9	-1.6	3.5	060	A12	Varies - See Map
Pacific Ocean							
Reach 1	0360	-3.4	-0.9	3.4	035	V7	25
Reach 2	0360	-0.4	-0.2	0.3	005	A1	5
Reach 3	0360	-1.8	-0.5	6.7	020	V4	17
Reach 4	0360	-2.7	-1.0	3.0	025	V5	21
Reach 5	0390	-1.6	-0.5	0.8	015	V3	22
Reach 6	0390	-1.5	-0.4	0.9	015	V3	26
Reach 7	0390	-1.5	-0.4	0.9	015	V3	30
Reach 8	0390	-2.3	-0.8	1.4	025	V5	31
Reach 9	0390	-1.5	-0.5	1.0	015	V3	26
Reach 10	0390	-0.8	-0.3	0.5	010	V2	21

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

SANTA CRUZ COUNTY, CA
(UNINCORPORATED AREAS)

FLOOD INSURANCE ZONE DATA

THOMPSON CREEK-ZAYANTE CREEK-PACIFIC OCEAN

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5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zone A0:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; depths are shown, but no FHFs are determined.
Zone AH:	Special Flood Hazard Areas inundated by types of 100-year shallow flooding where depths are between 1.0 and 3.0 feet; base flood elevations are shown, but no FHFs are determined.
Zones A1-A3, A5-A17, and A19-A22:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zones V2-V5, and V7:	Special Flood Hazard Areas along coasts inundated by the 100-year flood that have additional velocity hazards associated with waves of 3-foot amplitude or greater; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other local water-control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flood hazard; not subdivided.

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The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 9.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Santa Cruz County is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the NFIP.

6.0 OTHER STUDIES

A Flood Hazard Boundary Map for Santa Cruz County was published in 1979 (Reference 39). This study represents a more detailed analysis and, therefore, supersedes the Flood Hazard Boundary Map.

Information on flood problems in Santa Cruz County is contained in various Flood Plain Information reports and high-water mark data collected by the USGS. Flood Plain Information reports were prepared by the COE for Aptos Creek, the San Lorenzo River, Soquel Creek, and Corralitos Creek (References 7, 8, 9, and 10). The Flood Plain Information reports include profiles for the intermediate regional flood (100-year event) and the standard project flood (between the 100- and 500-year event). Because the 100-year event is the event for which profiles were determined in both this flood insurance study and the Flood Plain Information reports, only elevations from this event can be compared.

For the San Lorenzo River, differences of up to 8 feet exist between the two studies; however, elevations were usually different by less than 3 feet. The large differences could be explained by differences in the topographic mapping used to generate cross sections and differences in 100-year flows.

The COE cross sections were based on topographic maps with 5-foot contour intervals, while cross sections in this study were based on aerial surveys and maps with 4-foot contour intervals. The largest discrepancies in the water-surface elevations occurred where the largest differences in streambed elevations existed. The COE 100-year flows were 1 to 8 percent lower than flows generated in this study.

Water-surface elevations on Aptos Creek in this study were higher than the COE values by 8 feet at the mouth and by 1 to 4 feet upstream of Spreckels Drive bridge. Higher water-surface elevations were obtained because discharges used in this study were 45 to 60 percent higher than

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the COE flows. Flood profiles on Corralitos Creek between Lake Avenue and just downstream of Surich Lane generally agreed within 1 foot. Water-surface elevations for this study were generally 2 to 4 feet lower upstream of Surich Lane because of differences in streambed elevations. Agreement between 100-year profiles on Soquel Creek resulted when streambed elevations were in agreement. Upstream of Soquel Drive, streambed elevation differences of up to 8 feet produced differences in water-surface elevations of up to 4 feet.

High-water marks from the January 1982 storm were compared with elevations predicted from this study for the San Lorenzo River and Aptos, Branciforte, Soquel, and Zayante Creeks. Estimates of January 1982 storm-flows are preliminary and are available only at the gage stations. Therefore, for this comparison it was assumed that flows along the watercourse corresponded with the recurrence interval for the 1982 storm at the gage. Actual flows for the 1982 storm may have differed significantly from assumed flows depending on the contribution of tributary streams.

High-water marks along the San Lorenzo River above Cowell Park were between the predicted elevations for the 10- and 50-year events. The estimated flow at the Big Trees gage was 29,700 cfs corresponding to a recurrence interval of approximately 30 years. On Aptos, Branciforte, and Zayante Creeks, high-water marks for the January 1982 storm agreed within 1 foot of predicted elevations at their respective gages. Close agreement was also obtained along the lengths of these three streams except on Aptos Creek at the mouth below the confluence with Valencia and Trout Creeks. Below Spreckels Drive bridge on Aptos Creek, high-water marks were 3 to 6 feet below predicted elevations, probably because of scour and differences in flows. Elevations along Soquel Creek were within 1 to 2 feet of predicted water-surface elevations except at the mouth and upstream of the Soquel Drive bridge. At the mouth, high- water marks were 4 to 6 feet below computed elevations, probably because of scour and flow differences, and were 5 feet above computed elevations at the Soquel Drive bridge and at the Soquel gage because of bridge obstructions.

A Flood Hazard Boundary Map for unincorporated areas of San Benito County (Reference 40) is in agreement with this study.

Flood Insurance Studies have been produced for the Cities of Capitola (Reference 41), Santa Cruz (Reference 42), Scotts Valley (Reference 43), and Watsonville (Reference 44), and the unincorporated areas of Monterey County (Reference 45), Santa Clara County (Reference 46), and San Mateo County (Reference 47). The results of those studies match the Santa Cruz County Study.

The COE has studied flooding problems in the Pajaro River Valley and has compared flood control alternatives (References 6. 10, 11, 13, and 14). Data from these reports were used in establishing flood boundaries and elevations along the Pajaro River and its tributaries. Boundaries vary

somewhat from those determined in the 1974 COE report (Reference 14). The COE developed their 100-year flood boundary in the vicinity of Watsonville by assuming that the northern levee on the Pajaro River failed while the southern levee remained intact. This analysis produced the worst case for the Watsonville area. In this study, however, both levees were assumed to have failed, in accordance with FEMA guidelines for leveed streams.

Data used in this Flood Insurance Study, taken from the Ott Water Engineers studies (Reference 5), supersedes overlapping data from the COE study of the Monterey Bay area (Reference 24).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Building 105, Presidio of San Francisco, San Francisco, California 94129.

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